# C. Ecological Hazards

The following outline summarizes the significant ecological hazards covered in this section:

1. Wildfires
2. Invasive species

These types of natural hazards deal with biological ecosystems, and their effects upon the human economy and built environment. The most well-known hazard of this type is that of major wildfires. Although wildfires, like floods, occur naturally, dangers exist because humans live in areas where the disaster event will periodically take place and cause damage and threats to human health and life. Ecological hazards must also be dealt with to maintain Michigan's environmental and recreational quality of life, as well as the important economic sectors that are closely connected with them (such as tourism, recreation, agriculture, and natural resource extraction).

# Wildfires

*An uncontrolled fire in grasslands, brushlands or forested areas.*

***Hazard Description***

Forests cover approximately 49% (18.2 million acres) of Michigan's total land area. These vast forests provide Michigan with the largest state-owned forest system in the United States. In addition, Michigan has the fifth largest quantity of timberland acreage, with 4.2 million acres of softwoods and 13.1 million acres of hardwoods. That vast forest cover is a boon for both industry and recreation. However, it also makes many areas of Michigan highly vulnerable to wildfires.

Although Michigan's landscape has been shaped by wildfire, the nature and scope of the wildfire threat has changed. Michigan's landscape has changed substantially over the last several decades due to wildland development, and so the potential danger from wildfires has become more severe. Increased development in and around rural areas (more than a 60% increase in the number of rural homes since the 1980s) has increased the potential for loss of life and property from wildfires. (The map at the end of this section shows the wildland / urban interface areas of highest concern in Michigan.) There are simply not enough fire suppression forces available in rural areas to protect every structure from a disastrous wildfire.

Contrary to popular belief, lightning strikes are **not** the primary cause of wildfires in Michigan. Recently, only about 7% of all wildfires in Michigan were caused by lightning strikes, and most other causes have been attributed to human activity. Outdoor debris burning is the leading cause of wildfires in Michigan. Most Michigan wildfires occur close to where people live and recreate, which puts both people and property at risk. The immediate danger from wildfires is the destruction of property, timber, wildlife, and injury or loss of life to persons who live in the affected area or who are using recreational facilities in the area.

According to 2011 MDNR information, the leading causes of wildfires from 2001 to 2010 were:

1. Debris burning (32%)
2. Equipment (17%)
3. Miscellaneous (11%)
4. Unknown (10%)
5. Campfires (9%)
6. Lightning (7%)
7. Incendiary activity (5%)
8. Children (5%)
9. Railroads (3%)
10. Smoking (3%)

<u>Areas of Greatest Vulnerability</u>

The maps and tables at the end of this section show a breakdown of wildfires by county for the period since 1981, including both the number of fires and the number of acres burned. The maps indicate that the wildfire threat in Michigan is fairly widespread geographically. The large number of permanent and seasonal homes (especially in the northern Lower Peninsula), coupled with the increase in tourists during the most dry (and therefore most vulnerable) times of the year, greatly increase the risk from wildfires.

It should be noted that the figures shown on the maps do not include those wildfires suppressed by local volunteer fire departments or the U.S. Forest Service. If those records were readily available and broken down by county, the statistics would be significantly affected. For example, the 1976 Seney fire burned approximately 74,000 acres, which included federal, state and private lands. In addition, the statistics fail to show a major wildfire problem in the southern Lower Peninsula due to the small MDNR fire force presence in that area of the state. However, local fire departments in the southern Lower Peninsula respond to hundreds of wildfires per year, and are instrumental in keeping the wildfire threat in the southern Michigan counties in check.

In geographic terms, the percentage of forested land cover is the highest (more than 75% of the total land area) across the entire Upper Peninsula and in the Lower Peninsula counties of Cheboygan, Crawford, Kalkaska, Lake, Montmorency, Oscoda, Otsego, Presque Isle, and Roscommon (based upon a 2004 inventory by the USDA). The Michigan DNR has been involved in approximately 550 wildfire events per year, in recent decades. An average of about 4 deaths per year is estimated, from major events alone.

Role of Local Governments

Local governments can take a number of actions to reduce the risk from wildfires. One important action that can be taken at the local level is to adequately address wildfire vulnerability reduction in local zoning ordinances and comprehensive/land use plans. Most local zoning ordinances lack provisions for wildfire vulnerability reduction, and most comprehensive/land use plans are not prepared far enough in advance in rural areas to adequately direct development and institute mitigation measures in high-risk fire hazard areas. Communities are not adequately utilizing land use systems that recognize special fire problems and requirements related to vegetation, topography, weather, transportation and access, water supply, and density of development.

Local fire agencies, primarily due to lack of time and/or personnel, only sporadically review proposed lot splits, subdivisions, severances and other developments for fire protection needs. In general, communities are not requiring developers to project the fire vulnerability of their large-scale developments. These projections are also not required for most variances and special use permits. Builders seeking building permits for additions to homes do not have to retrofit the existing structure to meet wildfire safety and mitigation measures. These measures could include such actions as replacing an existing roof covering with a fire-resistant or non-combustible covering, installing smoke detectors and other fire safety controls, or maintaining a "Firewise" landscape by providing adequate vehicular access, signage streets, roads and buildings, and providing adequate emergency water supplies.

Additional measures that local governments can take to reduce wildfire vulnerability include restricting open burning of trash and yard debris (which causes nearly one-third of the wildfires in the state), and developing evacuation procedures for wildfires in the jurisdiction's Emergency Operations Plan (EOP) to minimize potential injury and loss of life.

Efforts of the MDNR Forest Management Division

The MDNR Forest Management Division is committed to a multi-jurisdictional, coordinated wildfire hazard mitigation effort. The Division is actively working toward reducing the State's vulnerability to wildfires by: 1) participating in multi-state and interagency mitigation efforts; 2) aiding local communities in developing zoning and subdivision control ordinances that adequately address wildfire mitigation; 3) regulating the days and times people are granted permits to burn debris; 4) conducting research on wildfire prevention, containment and suppression activities; and 5) developing wildfire hazard assessments to aid community and property owners in determining their vulnerability to wildfires.

The MDNR is conducting a detailed statewide assessment to determine communities' risks from wildfire, using Geographic Information System (GIS) technology. This assessment, which is expected to take several years to complete, will identify the areas of greatest concern for wildfires based on existing and projected land uses and population concentrations, as well as topography, hydrology, soils, vegetative cover, and other natural features. The assessment will provide the MDNR and other state agencies, local governments, builders and developers, and private citizens with information needed to make "Firewise" land use / development decisions and to facilitate the creation of community wildfire protection plans (CWPP), thereby reducing the wildfire threat to people and improved property. The risk map at the end of this section was the result of an early approximation using GIS and a basic model, but current mapping will result in products of far greater validity

Despite these ongoing initiatives of the MDNR Forest Management Division, wildfire prevention must be emphasized more at the local level if a meaningful reduction in vulnerability is to occur.

Wildfire Suppression

One trend involves wildfires outstripping the ability of firefighters to suppress them. Fire protection in wildland areas cannot be provided at the same level that it is provided in urban areas. Rural fire departments tend to be volunteer forces, the members of which may be widely geographically dispersed. That dispersion greatly increases the response

time in rural and wildland areas. In addition, these forces also tend to be not as well equipped as their urban counterparts. These factors, coupled with the tremendous increases in development in wildland areas and the lack of readily available water from pressurized underground pipes, contribute to the possibility of wildfire disasters in many areas of Michigan.

Wildfire Analysis

FEMA (and others) have created fairly detailed methods for estimating wildfire risks. The information in this workbook summarizes that given in FEMA publication 386-2 ("Understanding Your Risks"). It primarily uses weather, topography, and land cover (fuel) data to estimate wildfire risks. The first activity is to map the "fuel model" categories in the community. This process currently sorts all areas into three "fuel model" categories based on the types of vegetative land covers that could act as fuels in a wildfire event. Here is a summary of the three fuel model categories described by FEMA:

LIGHT FUEL CATEGORY – Covers any of the following general descriptions of vegetation in an area:

1. Predominantly marsh grasses and/or weeds.
2. Mosses, lichens, and low shrubs are the predominant ground fuels, but have no overstory and/or occupy less than one-third of the site.
3. Grasses and/or forbs predominate. Any woody shrubs will occupy less than one-third of the site. An open overstory of conifer and/or hardwood trees may be present.
4. Brush, shrubs, tree reproduction or dwarf tree species predominate, but this is only considered light fuel if the average height of woody plants is less than 6 feet, and they occupy less than one-third of the site.
5. Deciduous broadleaf tree species predominate and the area has not been thinned or partially cut (which would create a higher-risk fuel source called "slash.")
6. Conifer species predominate, but the primary ground fuels are grasses and forbs. If the primary ground fuels are duff and litter, branch wood, and tree boles, then the area can only be considered "light fuel" if pine needles are 2 or more inches in length, the overstory is not decadent, and there is only a nominal accumulation of debris.

MEDIUM FUEL CATEGORY – Covers any of the following general descriptions of vegetation in an area:

1. Mosses, lichens, and low shrubs are the predominant ground fuels, and an overstory of conifers occupies more than one-third of the site.
2. Grasses and/or forbs predominate, with woody shrubs occupying between one-third and two-thirds of the site.
3. Brush, shrubs, tree reproduction or dwarf tree species predominate, and woody plants are either greater than 6 feet in height, or cover more than one-third of the site.
4. Conifer species predominate, and the understory is dominated by lichens, mosses, low shrubs, woody shrubs, and/or reproduction. (If the primary ground fuels are duff and litter, branch wood, and tree boles, and pine needles are less than 2 inches long, then the overstory must not be decadent, and there must be only a nominal accumulation of debris.)

HEAVY FUEL CATEGORY – Covers any of the following general descriptions of vegetation in an area:

1. Deciduous broadleaf tree species predominate in an area that has been thinned or partially cut, leaving slash as the major fuel component.
2. Conifer species predominate, with duff and litter, branch wood, and tree boles as the primary ground fuels, and an overstory that is overmature and decadent, with a heavy accumulation of dead tree debris.
3. Slash is the predominant fuel in the area. (Counts as heavy fuel at any level of loading, regardless of whether settling has been significant or slight, and whether foliage is attached or falling off.)

The United States Department of Agriculture has created a site with wildfire analysis resources, at http://www.fs.fed.us/fire/science/index.html. Since USDA assesses fire risks nationwide, local or state resources will probably be needed to supplement this source in order to accurately assess a community's specific fuel model areas in the local hazard mitigation plan.

FEMA's wildfire model then combines these fuel type areas with assessments of local topography and weather patterns, to identify overall risk categories (called "moderate hazard," "high hazard," and "extreme hazard.") Topographic information provides three land categories, based on the severity of slopes present in an area. Low slope

areas have slopes less than or equal to 40%. Moderate slope areas contain slopes measuring from 40% to 60%. Steep slope areas contain slopes greater than 60%.

Weather information can produce estimates of the number of days per year with "critical fire weather" conditions. FEMA has stated that a local or state fire marshal, forestry department, or department of natural resources can help in determining the number of days per year that critical fire weather is experienced in an area.

Overall categories of wildfire risk (moderate, high, and extreme) are given by the following FEMA table:

| | Frequency of Critical Fire Weather | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 day per year or less | | | 2 to 7 days per year | | | 8 or more days per year | | |
| Fuel Classification | Slope ≤40% | Slope 41%-60% | Slope ≤60% | Slope ≤40% | Slope 41%-60% | Slope ≥60% | Slope ≤40% | Slope 41%-60% | Slope ≤60% |
| Light Fuel | Moderate | Moderate | Moderate | Moderate | Moderate | Moderate | Moderate | Moderate | High |
| Medium Fuel | Moderate | Moderate | High | High | High | High | Extreme | Extreme | Extreme |
| Heavy Fuel | High | High | High | High | Extreme | Extreme | Extreme | Extreme | Extreme |

Additional factors that increase fire risk and may be included in a model include lightning and human factors such as the number of persons residing in, camping in, visiting, or traveling through an area. Such persons may increase fire risks through carelessness or ignorance, while other persons (including residents and fire spotters) may reduce risk of uncontrolled wildfire in an area, through their ongoing fire awareness, prevention, and response activities. It also makes sense to take into account the type of fire-fighting personnel, equipment, expertise, and related resources (such as water) that are available to a community, or lacking in adjacent communities (from which a fire might spread).

Vulnerable structures are those located in or near a potential wildfire area, unless they have taken special steps to become "Firewise" (as described previously). Nonflammable roof and patio materials, clearance of vegetation and maintenance of a defensible space around structures, available means to provide and facilitate site access by emergency responders, and so on, will make a structure potentially able to withstand wildfire events in its vicinity. Structures that are located in a wildland/urban interface area should be evaluated for these sorts of site features that will exacerbate or minimize their vulnerability. Certain design or landscaping features can render an at-risk structure completely vulnerable to any nearby wildfire event, and thus should be prioritized for wildfire mitigation strategies. Although risk-estimation models exist, FEMA has stated that there are no standardized methods for estimating the amount of damages and economic losses that a community will sustain from a wildfire event.

Impact on the Public

Wildfires can cause widespread concerns and disruptions even in cases where physical damages have been prevented. Smoke, closed roadways, and infrastructure impacts may interfere with ordinary life, as well as an area's economy and planned events (including tourism). Wildfires can also directly cause structural fires to occur. (Please refer to the preceding sections about structural and scrap tire fire events for more information about these potential impacts.)

Impact on Public Confidence in State Governance

The large scale of wildfires can cause widespread concerns and disruption, smoke, closed roadways, and infrastructure impacts. Since many wildfire locations involve state lands (especially the Michigan Department of Natural Resources), major wildfire events may raise public questions about the effectiveness of governmental policies toward the maintenance and monitoring of conditions on such lands.

Impact on Responders

Wildfires involve special training, equipment, and expertise, as well as a large-scale response and different types of risks for responders, including the large areas involved, the risks of extremely rapid fire spread, and locations that are often isolated and distant. These tend to present difficulties with responder equipment staging, transport, coordination, and communications.

Impact on the Environment

Wildfire impacts on Michigan's environment can be considerable, due to the fact that Michigan has the largest state-owned forest system in the Eastern United States, as well as the fifth largest timber acreage in the country. Wildfires physically damage natural vegetation, forests, trees, shrubs, grasslands, native animals and insect species, etc, leaving black soot, deposits of peat, smolder, and charcoal-like ground cover that can contaminate the soil and underground

water table. Wildfires can also cause dramatic and immediate changes or shock in vegetation, eliminating some species or causing others to appear where they were not present before the fire. Wildfires (depending on their size and burning time) are a significant source of gases and particulates in the atmosphere, including carbon dioxide, carbon monoxide, methane, non-methane hydrocarbons and oxides of nitrogen. Fire also produces large amounts of small, solid particles (particulate matter) that absorb and scatter solar radiation, exacerbating climate change conditions.

Even though many fires occur close to where human residences are located, they are a normal ecological phenomenon and serve long-term functions for vegetation and the natural environment. Wildfires burn excess brush, maintain large savannah-like openings, and restore wetlands by forcing out various unwanted brush and plants. The natural function of fires within the environment can be considered a renewal or "cleansing process" as long as the fire is not too severe.

***Significant Wildfires***

Michigan has experienced many destructive wildfires. Thousands of homes (during Michigan's first century) and millions of acres of forest have been destroyed by wildfires. According to Michigan Department of Natural Resources (MDNR) and U.S. Forest Service records, over 5.8 million acres of forest in Michigan were burned between 1910 and 1949, an average of 145,000 acres per year. By comparison, it was reported that between 1950 and 1996, the MDNR and U.S. Forest Service were involved in suppressing over 46,100 wildfires that burned 390,000 acres of forest, which averages only 8,300 acres burned per year. This drastic reduction in the acres of timber burned was largely the result of (1) increased use of specialized equipment to suppress the fires, and (2) intensified efforts toward fire prevention. The following list summarizes some of the largest and most severe wildfires that have occurred in Michigan to date.

## Significant Michigan Wildfires

### October 1871 - Lower Peninsula

The State's first recorded catastrophic fire occurred in the fall of 1871, after a prolonged drought over much of the Great Lakes region in the summer of 1871. The drought had left debris from logging and land clearing tinder dry, and as a result numerous fires burned throughout the state. These fires continued to smolder until, on October 8th of that year, gale and hurricane force winds fanned a series of fires across much of the northern Lower Peninsula. Because this tremendously destructive wildfire occurred at the same time as the great wildfires that struck Peshtigo, Wisconsin (which killed 1,300 people in a single night, and also affected Menominee County in the Upper Peninsula) and the Great Chicago Fire (which destroyed much of central Chicago), the Michigan wildfire received little publicity. However, the 1871 Michigan wildfire killed 200 people and burned 1.2 million acres. When the winds finally subsided, the fire's swath stretched from Lake Michigan across to Lake Huron. The most heavily affected area, north of Saginaw Bay, had an area 40 miles square that was completely destroyed, with over 50 people killed. The worst of the fire was over by October 19, although the fire wasn't completely extinguished for over a month.

### August-September 1881 - Thumb Area

On August 31, 1881, several small fires in the Thumb came together to form a major conflagration (commonly known as the Thumb fire). A massive area of fires moved through the Thumb counties, and six days later, stopped at Lake Huron. This fire was, in many ways, more severe than the 1871 fire, since settlers had moved into the region in large numbers and logging had gotten underway. More than a million acres were burned; property loss exceeded $2 million, and 282 were killed. Like the 1871 fire, the fire of 1881 came at the end of an extremely severe drought and was the result of hundreds of land-clearing fires being brought together into a conflagration by high winds.

### Summer 1896 – Ontonagon Fire

A dry summer exacerbated fire conditions and winds also helped to spread a wildland blaze to the town of Ontonagon, which saw heavy destruction as a result. More than 340 buildings were burned, and hundreds of residents were displaced to nearby farms and the nearby town of Rockland. Animals died and humans were injured, but fortunately, only one person was actually killed in the disaster.

### October 1908 – Metz Fire (Presque Isle County)

Droughts in northern Michigan exacerbated wildfire conditions and threatened the town of Metz. Some of the evacuating residents tried to flee by train, but the train was wrecked near the station at Hawks by a burned out culvert, killing 14 passengers, plus two persons who lived at a nearby home. Since the train had found its path blocked by flames, it had attempted to proceed backwards toward Metz and Alpena, but had failed in the effort.

### July 1911 – Au Sable-Oscoda Fire (Iosco County, and also Cheboygan, Crawford, and Otsego Counties)

Enormous wildfires ravaged the northern Lower Peninsula and caused massive destruction at the towns of Oscoda and Au Sable, whose 1,800 residents were evacuated by train and steamboat. At Cheboygan, a huge pile of sawdust had been burning for weeks and was beyond control. A railroad suffered heavy losses near Grayling, including 40 cars and two bridges. Fires at Oscoda and Alpena were reported to have started at slab yards. Damages were estimated at $100,000 in Alpena, and $500,000 in Oscoda and Au Sable. The town of Waters suffered $300,000 in damage to property and at least as much to lumber. At least 500 evacuees were sheltered at Tawas City and East Tawas. Total losses across the area were estimated as at least $1.5 million. Several casualties were reported, but the total number actually killed in the disaster was not clear from reports.

### May 1968 – Crawford and Kalkaska Counties

The "Fletcher Road Fire" was started at approximately 2:45pm on May 8, 1968, by a pipeline welding crew whose company later paid out more than $90,000 in damages for timber losses. Tree mortality was almost total within an area of 4,216 acres across Kalkaska and Crawford Counties, and the fire crowned (reached the tree tops) in over 75% of that area. Crown fires like this allow the fire to advance and spread rapidly. The fire was able to "jump" across Fletcher Road and burned at a rate of approximately 2 miles per hour, which is considered to be a fast-moving fire. Smoke could be seen from as far as 20 miles away. A million-dollar gas refinement facility was placed at-risk by the fire, but protected by responder efforts.

### August-September 1976 - Seney (Schoolcraft County)

In the late summer months of August and September 1976, a fire near Seney burned approximately 74,000 acres. At least part of the fire was started by lightning and quickly became uncontrollable due to an abundance of flammable material brought on by drought conditions. However, there were also problems involving prescribed, controlled burns and smoldering areas that later reignited and thus created unusual problems. The fire started on federal land and spread to state and privately owned lands. Fire suppression and damage costs exceeded $8 million.

## May 1980 - Oscoda County

In May 1980, a wildfire in Oscoda County (known as the Mack Lake fire) destroyed 44 homes and buildings, forced the evacuation of 1,500 people, and killed one firefighter. A total of 24,000 acres were burned, resulting in a total property and timber loss of $2 million. The fire has been claimed to have stemmed from a prescribed burn that got out of control when it "jumped" across a highway. It has been claimed that a major wildfire occurs about every 20 to 30 years in the area.

## May 1986 - Marquette County

In May 1986, multiple wildfires in Marquette County burned 7,000 acres and forced the evacuation of 4,000 people at K.I. Sawyer Air Force Base when flames spread right up to some of the housing units.

## July 1988 – Escanaba (Delta County)

A large fire caused the evacuation of 60 families and the temporary closure of Highway U.S.-2. Two firefighters were injured battling what became known as the "Stockyard Fire," a name given because the fire area included a site that had previously been used as a stockyard. Again, conditions were exacerbated by regional drought effects.

## May 1990 - Grayling (Crawford County)

In May 1990, a wildfire near Grayling in Crawford County (known as the Stephan Bridge Road fire) burned 76 homes and 125 other structures, 37 vehicles and boats, and over 5,900 acres of forestland, resulting in property losses of $5.5 million. The timber losses totaled another $700,000. The fire originated from a controlled burning of a pile of brush and timber accumulated from recently cleared land. The burning was initiated while snow covered the ground, and it had been presumed that the fire was completely extinguished. However, the pile rekindled approximately seven weeks later, and on May 8, ignited the Stephan Bridge Road fire. Strong winds and dry conditions helped spread the fire at a rate beyond that which could be controlled by human intervention. At one point in the fire, the rate of spread was an astonishing 277 feet per minute. Fortunately, the combination of human fire suppression and a passing weather front that produced rainfall finally contained the fire before it could do any additional damage. There were no fatalities as a result of this fire, and only one firefighter was injured from smoke inhalation. However, the property losses were significant.

## May 2-7, 1999 - Champion (Marquette County), Epoufette (Mackinac County), Oscoda County

In early May 1999, a wildfire near the village of Champion in Marquette County (known as the Tower Lake fire) burned a total of 5,625 acres of forestland, destroyed at least 8 structures (about 7 more were damaged), and forced the evacuation of 450 persons in Champion as well as those in the vicinity of Fish Lake, Perch Lake, Mud Lake, eastern Michigamme, and Van Riper State Park. In addition, the fire forced the closure of US-41 and M-95 in the area of Champion and Michigamme for several days, and 10 bridges were burned. Timber losses were estimated at $12.8 million, with property losses totaling another $960,000. Aerial firefighting assets were brought in from surrounding areas to help prevent the spread of the fire into Champion, thus saving the town from destruction. At the request of the Governor, the Federal/State Forest Fire Suppression Agreement was activated by the Federal Emergency Management Agency (FEMA) to provide financial assistance to the State and eligible local agencies to cover some of the firefighting costs incurred. At about the same time as the Tower Lake fire, major wildfires were also being fought in several other locations across Northern Michigan. In Mackinac County, an 850-acre fire burned for several days near Epoufette, while another 850-acre fire burned in the Huron-Manistee National Forest in Oscoda County. In the Northern Lower Peninsula alone during that first week of May, MDNR forces fought nearly 40 wildfires. All of the wildfires were fueled by the same dry conditions that set the stage for the Tower Lake fire.

## May-June 2000 - Mio (Oscoda County), Torch Lake Township / Lake Linden (Houghton County)

A wildfire that began on April 30 near Mio and was fed by extremely dry conditions consumed nearly 5,200 acres in the Huron-Manistee National Forest before being contained a week later. Nearly 300 firefighters and two aerial water tankers were deployed to suppress the fire. The fire prompted the evacuation of approximately 30 persons for a short time. Fortunately, the fire did not cause any injuries or structural damage. About a month later, on June 6, a brush fire set on a blueberry farm near Rice Lake in Torch Lake Township, Houghton County, got out of control and eventually burned over 350 acres before being contained the next day. Firefighters from the MDNR and 15 local fire departments, plus two aerial water tankers, were called to fight the blaze. The fire forced the evacuation of over 20 homes and cottages, and at one point was one-half mile wide and almost one mile long. Brisk winds pushed the fire to within one-quarter mile of homes along the shoreline of Lake Superior. However, no structures were lost and no injuries were reported.

## March-April 2005 – Roscommon County

A long period of warm and dry weather affected northern Michigan from the end of March through mid April. Once the spring snow melt was completed, the fire danger rapidly increased. A number of wildfires developed in northern Lower Michigan in mid-April. The largest occurred in Nester Township in Roscommon County. This fire (of unknown origin) started on the afternoon of the 16th, and burned over 1,500 acres before it was gradually brought under control over the next several days. There was no known structural damage, though sixteen to twenty homes in the area were evacuated.

## April 30 to May 1, 2006 – Oscoda County

A wildfire in Hughes Lake began early in the afternoon of April 30th, ignited by an individual burning brush in a fire pit. The fire spread northwest from Hughes Lake, thanks to southeast winds of 10 to 20 mph. The rate of spread reached as high as 2 miles per hour late in the afternoon of the 30th, with flame heights reaching 300 feet tall. Stands of jack pine, which burn very readily, contributed to the intensity of the fire. Containment activities brought the fire under control by late afternoon of May 1st, although mop-up would continue for several days after. Crews were flown in from as far away as New Mexico and Montana to fight the fire. At its height, almost 300 personnel were involved in fighting the fire. Approximately 5,950 acres of timber and brush land burned, south of M-72, east of M-18, and west of M-33. Sixteen structures and seven vehicles were destroyed—most structures were seasonal and not residential, but an American Red Cross shelter in Luzerne hosted seven persons. A number of evacuations were ordered, some as far west as M-18 in southeast Crawford County, although most residents returned to their homes within a few days. Total damage to property was conservatively estimated at $600,000. Note that this does not include costs incurred in fighting the fire, which were in excess of $800,000.

## April 27-30, 2007 – Baraga County

A wildfire in Baraga, which started as a controlled burn by the U.S. Forest Service on the 27th, went out of control by the 29th, fueled by low relative humidity and strong winds gusting over 40 mph. The wildfire consumed more than 1,300 acres in western Baraga County between the 27th and 30th. More than 120 firefighters from the U.S. Forest Service and the Michigan DNR battled the blaze and helped authorities evacuate thirty homes in the Covington area. No injuries or structural damages were reported from the fire. Another fire in northwest Marquette County destroyed three structures and burned approximately 60 acres before it was brought under control on the 29th.

## August 2007 – Luce County

On August 2, a lightning strike ignited a fire in central Luce County and grew to disastrous proportions, burning nearly 19,000 acres and resulting in a governor-declared State of Emergency. More than 220 personnel were involved in fire containment and suppression operations, from local, state, and federal agencies. Fortunately, the relatively remote location caused a limited number of properties to be lost. However, residents had to be evacuated three separate times during the substantial event period. Despite the substantial risks to nearby residents and facilities, efforts to obtain a federal disaster declaration were unsuccessful.

## April 24, 2008 – Crawford County

Called the "Four Mile Road Fire," the cause may have been some sparks from a passing train. A Red Flag warning had been in effect when the fire started a few miles south-southeast of Grayling. The weather was warm, dry, and windy, and the fire quickly expanded to the northwest, crossing I-75 (which was closed for several hours) and eventually burning 1,300 acres. On the far south side of Grayling, a gas station and motel were threatened, but spared damage. About a half-dozen cabins near Simpson Lakes were lost (about two miles south of downtown Grayling), and $287,000 in damage was sustained by the Grayling Game Club. Total property damages from the event were estimated at $750,000, and MDNR response costs and timber damages were about $619,000. Fifty homes were

evacuated, and power was lost in Grayling. By the evening, winds and temperatures went down and several periods of rain during the night helped the fire to be extinguished.

### May 20 to 26, 2009 – Marquette and Baraga Counties

Southwest of Ishpeming, the "Black River Falls Wildfire" started on the afternoon of May 20 when a wind-damaged pine tree fell across a power line. The wildfire destroyed 21 homes, 12 other structures, and caused an estimated $4 million in property damage. The fire had burned 811 acres but was contained by the 22nd, and final clean-up took until the 26th. Personnel and equipment costs to fight the fire were estimated at $100,000 in Marquette County. During the same time period, in neighboring Baraga County, a "Pinery Wildfire" started in an area east of L'Anse and burned 685 acres before being contained two days later (with final clean-up also lasting until the 26th). About $50,000 in property damage was caused when flames destroyed a mobile home and damaged the Pinery Ski Lake trails area and a nearby cemetery. Firefighting costs for the Baraga event approached $125,000.

### May 18 to 26, 2010 – Crawford and Kalkaska Counties

A debris fire expanded out of control and resulted in the "Meridian Boundary Fire" by about 1:30pm on May 18. A total of 8,800 acres were eventually burned by this fire, which took until May 26 to reach 95% containment. Twelve residences were destroyed, six were damaged, and 36 outbuildings were either destroyed or damaged, resulting in total property damages of about $825,000. Also on May 18, in adjacent Kalkaska County, the "Range 9 Fire" started when a controlled burn on an artillery range became uncontrolled as winds increased through the area. The Range 9 Fire burned 1,100 acres of mostly grassy areas on the Camp Grayling grounds, but also crossed over the boundary line at one point and destroyed 4 seasonal homes in Blue Lake Township, resulting in an estimated $125,000 in property damage. By late evening on the same date, that smaller fire was under control.

### May 20 to 31, 2012 – Luce County

About $12 million in property damage resulted from the Duck Lake Wildfire in Luce County, which was ignited by lightning strikes from a line of thunderstorms. The fire started 14 miles north of Newberry and the simultaneous Pine Creek North Wildfire seriously affected large parts of the Seney National Wildlife Refuge. Fanned by strong south winds, the fire spread rapidly toward the shoreline of Lake Superior and forced people in the Pike Lake, Bodi Lake, Culhane Lake, and Little Lake Harbor areas to evacuate. Major roads across that area were closed. A total of 136 structures were burned (including one store and one motel) and the wildfire affected 21,069 acres before it was fully contained in mid-June. The Duck Lake event was the third largest in modern Michigan history. About $600,000 in resources were expended to fight the fire. A governor's state of disaster was declared for Luce and Schoolcraft Counties on May 25.

## *Programs and Initiatives*

Michigan Department of Natural Resources Forest Management Division

The MDNR Forest Management Division directs and coordinates wildfire prevention, containment and suppression activities on all non-federal lands in the state, as well as Indian Reservations (under contract with the U.S. Bureau of Indian Affairs). The MDNR places great emphasis on wildfire prevention and public education, since the vast majority of wildfires in Michigan are caused by human activity. The MNDR Forest Management Division's philosophy is that preventing fires from starting in the first place, and precautionary measures around rural homes, are the best means of avoiding or minimizing wildfire losses. When conditions of extreme fire hazard exist, the MDNR can request the Governor to issue an outdoor burning ban to mitigate the potential for wildfire in all or part of the state. Such a ban restricts smoking, fireworks, and outdoor burning activities to approved locations.

Michigan Forest Fire Experiment Station

A string of disastrous wildfires in the early 20th century led to the creation of the Michigan Forest Fire Experiment Station in 1929. This Station, established by what was then the Michigan Department of Conservation (now the Department of Natural Resources) and located in Roscommon, is designed to investigate how wildfires behave, how to properly manage forest fuels, and how to use mechanized equipment to fight wildfires. Its research efforts have been invaluable in helping to prevent, contain and suppress wildfires in Michigan and across the country.

Michigan Interagency Wildland Fire Protection Association

Because the vast majority of wildfires are caused by human activity, the Michigan Department of Natural Resources established, in 1981, the Michigan Interagency Wildfire Prevention Group. It was the first such group in the nation (promoting wildfire prevention and awareness) that had the full involvement of the state's fire agencies. In 1993, the Michigan Interagency Wildfire Prevention Group was expanded to form the Michigan Interagency Wildland Fire Protection Association (MIWFPA). The MIWFPA promotes interagency cooperation in fire prevention, training, fire technology, and firefighting operations. Members of the MIWFPA include the: 1) MDNR Forest Management Division; 2) USDA Forest Service - Huron-Manistee, Hiawatha, and Ottawa National Forests; 3) USDI National Park Service - Pictured Rocks and Sleeping Bear Dunes National Lakeshores; 4) USDI Fish and Wildlife Service - Seney National Wildlife Refuge; 5) USDI Bureau of Indian Affairs; 6) Michigan Department of State Police - fire investigation; 7) Michigan State Firemen's Association; and the 8) Michigan Fire Chief's Association.

Michigan Natural Resources and Environmental Protection Act

The Michigan Natural Resources and Environmental Protection Act (1994 PA 451), Part 515, assigns responsibility for the prevention and suppression of forest fires to the Director of the Michigan Department of Natural Resources. The Act also establishes requirements for burning permits, allows the Governor to issue prohibitions against the use of fire during extreme fire hazard conditions, and allows the MDNR Director to enter into forest fire assistance agreements

with other states and the federal government to control forest fires. These measures contribute to forest fire mitigation by preventing forest fires from starting in the first place, or lessening the spread of fires when they do start (and thus preventing further damage from occurring).

Solid Waste Management Act

The Michigan Solid Waste Management Act (1990 PA 264) prohibits the burning of leaves and grass clippings in municipalities with more than 7,500 population, unless a municipality has an ordinance expressly allowing such burning activities. When properly applied and enforced, this law helps prevent some wildfires, since roughly one-quarter of all wildfires are started by small residential waste fires that get out of control.

Great Lakes Forest Fire Compact

In the Great Lakes region, more than one-third of the 6,000 wildfires that occur annually are caused either by careless burning by residents or children playing with matches. The MDNR Forest Management Division is a member of the Great Lakes Forest Fire Compact in an effort to reduce these fires. The Compact is a partnership between the states of Michigan, Wisconsin and Minnesota, and the Canadian provinces of Ontario and Manitoba. Its purpose is to promote effective prevention, pre-suppression, and control of wildfires in the Great Lakes region through mutual aid and cooperation. Initiatives are implemented by committees composed of members of the Compact. An example of an activity the Compact has undertaken is the development of a fire hazard assessment for the region. Michigan took the lead on this project, and it has proven to be an extremely beneficial educational tool for communities and property owners in assessing their fire hazard potential.

The efforts of the Compact to build coordination and cooperation are based on the understanding that wildfires are multi-jurisdictional, and that suppression of fires usually requires the efforts of many groups and jurisdictions.

"Firewise Communities" Wildfire Protection Program

The MDNR is a participant in the national "Firewise Communities" Program developed by the National Wildland-Urban Interface (WUI) Fire Protection Program. The WUI Fire Protection Program is sponsored by the nation's major wildland fire agencies and the National Fire Protection Association (NFPA). In addition to the NFPA, other sponsors include the: 1) USDA Forest Service; 2) USDI; 3) USDI National Park Service; 4) USDI Bureau of Land Management; 5) USDI Bureau of Indian Affairs; 6) USDI U.S. Fish and Wildlife Service; and the 7) National Association of State Foresters. These member agencies have been promoting "Firewise" living since 1986.

The Firewise Communities Program is designed to educate governmental officials and professionals in a wide variety of disciplines (e.g. planners, builders, engineers, architects, bankers, insurance representatives, emergency managers, land managers) on ways in which communities can be designed and built to minimize the threat from wildfires. The current focus of that educational effort is a series of Firewise Communities Workshops being held around the country. At the Workshops, participants use computerized mapping and wildfire simulations to learn how to recognize wildland -urban interface fire hazards, design Firewise homes and landscapes, deliver fire education, and integrate Firewise planning into existing and developing areas of communities. The Firewise Communities Program also produces and distributes guidance documents, videos, and software packages on wildland-urban interface fire issues.

Although the MDNR had worked with the City of Grayling in a pilot program during an effort to promote this initiative, there are at the current time no communities officially recognized as Firewise communities in Michigan.

Wildfire Prevention Week

Due to the high risk of wildfires in Michigan, the state observes Wildfire Prevention Week sometime in April every year. Most Michigan wildfires are human-caused, with one-third caused by people burning debris. An increasing number of people moving into rural areas surrounded by fire-prone vegetation makes preventing wildfires in these areas a critical public safety issue for everyone. The economic value that Michigan forests contribute, in the form of travel, eco-tourism, hunting, fishing, camping and other recreational uses, and timber-related products, is an estimated 200,000 jobs and $12 billion annually. Officials throughout Michigan have stressed that thoughtful activity by humans is critical to preventing wildfires.

***Mitigation Alternatives for the Wildfire Hazard***

- Proper maintenance of property in or near wildland areas (including short grass; thinned trees and removal of low-hanging branches; selection of fire-resistant vegetation; use of fire resistant roofing and building materials; use of functional shutters on windows; keeping flammables such as curtains securely away from windows or using heavy fire-resistant drapes; creating and maintaining a buffer zone (defensible space) between structures and adjacent wild lands; use of the fire department's home safety inspections; sweeping/cleaning dead or dry leaves, needles, twigs, and combustibles from roofs, decks, eaves, porches, and yards; keeping woodpiles and other combustibles away from structures; use of boxed or enclosed eaves on houses; thorough cleaning-up of spilled flammable fluids; and keeping garage areas protected from blowing embers).
- Safe disposal of yard and house waste rather than through open burning.
- Use of fire spotters, towers, planes.
- Use of structural fire mitigation systems such as interior and exterior sprinklers, smoke detectors, and fire extinguishers.
- Arson prevention activities, including reduction of blight (cleaning up areas of abandoned or collapsed structures, accumulated junk or debris, and lands with a history of flammable substances stored, spilled, or dumped on them).
- Public notification of fire weather and fire warnings.
- Prescribed burns and fuel management (thinning of flammable vegetation, possibly including selective logging to thin out some areas. Fuels cleared can be given away as firewood or made into wood chips for distribution.)
- The creation of fuel breaks (areas where the spread of wildfires will be slowed or stopped due to removal of fuels, or the use of fire-retardant materials/vegetation) in high-risk forest or other areas.
- Keeping roads and driveways accessible to vehicles and fire equipment—driveways should be relatively straight and flat, with at least some open spaces to turn, bridges that can support emergency vehicles, and clearance wide and high enough for two-way traffic and emergency vehicle access (spare keys to gates for properties should be provided to the local fire department, and an address should be visible from the road so homes can be located quickly).
- Enclosing the foundations of homes and buildings rather than leaving them open with their underside exposed to blown embers or materials.
- Safe use and maintenance/cleaning of fireplaces and chimneys (with the use of spark arresters and emphasis on proper storage of flammable items). Residents should be encouraged to inspect chimneys at least twice a year and clean them at least once a year.
- Proper maintenance and storage of motorized equipment that could catch on fire (from blown embers, etc.)
- Proper storage and use of flammables, including the use of flammable substances (such as when fueling machinery). Store gasoline, oily rags and other flammable materials in approved safety cans. Stack firewood at least 100 feet away and uphill from homes.
- Avoid building structures on hilltop locations, where they will be at greater risk from wildfires (in addition, hillsides facing south or west are more vulnerable to increased dryness and heat from sun exposure).
- Use of proper setbacks from slopes (outside of the "convection cone" of intense heat which would be projected up the slope of the hill as a wildfire "climbs" it).
- Have adequate water supplies for emergency fire fighting (in accordance with NFPA standards).
- Obtaining insurance.

***Tie-in with Local Hazard Mitigation Planning***

Because many means of implementing mitigation actions occur through local activities, this updated MHMP places additional emphasis on the coordination of State-level planning and initiatives with those taking place at the local level. This takes two forms:

1. The provision of guidance, encouragement, and incentives to local governments by the State, to promote local plan development, and
2. The consideration of information contained in local hazard mitigation plans when developing State plans and mitigation priorities.

Regarding the first type of State-local planning coordination, MSP guidance has included the “Local Hazard Mitigation Planning Workbook” (EMD-PUB 207), which is currently being updated for release by 2015. For the second type of State-local planning coordination, a section later in this plan summarizes hazard priority information as

it has been reported in local hazard mitigation plans. Here, it will merely be noted that wildfires were identified as one of the most significant hazards in local hazard mitigation plans for the following counties: Alcona, Arenac, Benzie, Charlevoix, Clare, Crawford, Emmet, Gogebic, Grand Traverse, Hillsdale, Iosco, Iron, Kalkaska, Lake, Luce, Manistee, Marquette, Missaukee, Ogemaw, Osceola, Oscoda, Otsego, Sanilac, and Wexford.

Wildfire Guidance for Local Hazard Mitigation Planning

FEMA (and others) have created fairly detailed methods for estimating wildfire risks. The information in this workbook summarizes that given in FEMA publication 386-2 ("Understanding Your Risks"). It primarily uses weather, topography, and land cover (fuel) data to estimate wildfire risks. The first activity is to map the "fuel model" categories in your community. This process currently sorts all areas into three "fuel model" categories based on the types of vegetative land covers that could act as fuels in a wildfire event. Here is a summary of the three fuel model categories described by FEMA:

LIGHT FUEL CATEGORY – Covers any of the following general descriptions of vegetation in an area:

1. Predominantly marsh grasses and/or weeds.
2. Mosses, lichens, and low shrubs are the predominant ground fuels, but have no overstory and/or occupy less than one-third of the site.
3. Grasses and/or forbs predominate. Any woody shrubs will occupy less than one-third of the site. An open overstory of conifer and/or hardwood trees may be present.
4. Brush, shrubs, tree reproduction or dwarf tree species predominate, but this is only considered light fuel if the average height of woody plants is less than 6 feet, and they occupy less than one-third of the site.
5. Deciduous broadleaf tree species predominate and the area has not been thinned or partially cut (which would create a higher-risk fuel source called "slash.")
6. Conifer species predominate, but the primary ground fuels are grasses and forbs. If the primary ground fuels are duff and litter, branch wood, and tree boles, then the area can only be considered "light fuel" if pine needles are 2 or more inches in length, the overstory is not decadent, and there is only a nominal accumulation of debris.

MEDIUM FUEL CATEGORY – Covers any of the following general descriptions of vegetation in an area:

1. Mosses, lichens, and low shrubs are the predominant ground fuels, and an overstory of conifers occupies more than one-third of the site.
2. Grasses and/or forbs predominate, with woody shrubs occupying between one-third and two-thirds of the site.
3. Brush, shrubs, tree reproduction or dwarf tree species predominate, and woody plants are either greater than 6 feet in height, or cover more than one-third of the site.
4. Conifer species predominate, and the understory is dominated by lichens, mosses, low shrubs, woody shrubs, and/or reproduction. (If the primary ground fuels are duff and litter, branch wood, and tree boles, and pine needles are less than 2 inches long, then the overstory must not be decadent, and there must be only a nominal accumulation of debris.)

HEAVY FUEL CATEGORY – Covers any of the following general descriptions of vegetation in an area:

1. Deciduous broadleaf tree species predominate in an area that has been thinned or partially cut, leaving slash as the major fuel component.
2. Conifer species predominate, with duff and litter, branch wood, and tree boles as the primary ground fuels, and an overstory that is overmature and decadent, with a heavy accumulation of dead tree debris.
3. Slash is the predominant fuel in the area. (Counts as heavy fuel at any level of loading, regardless of whether settling has been significant or slight, and whether foliage is attached or falling off.)

FEMA's wildfire model then combines these fuel type areas with assessments of local topography and weather patterns, to identify overall risk categories (called "moderate hazard," "high hazard," and "extreme hazard.") Topographic information provides three land categories, based on the severity of slopes present in an area. Low slope areas have slopes less than or equal to 40%. Moderate slope areas contain slopes measuring from 40% to 60%. Steep slope areas contain slopes greater than 60%.

Weather information can produce estimates of the number of days per year with "critical fire weather" conditions. FEMA has stated that a local or state fire marshal, forestry department, or department of natural resources can help in determining the number of days per year that critical fire weather is experienced in your area.

Overall categories of wildfire risk (moderate, high, and extreme) are given by the following FEMA table:

| | Frequency of Critical Fire Weather | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 day per year or less | | | 2 to 7 days per year | | | 8 or more days per year | | |
| Fuel Classification | Slope ≤40% | Slope 41%-60% | Slope ≤60% | Slope ≤40% | Slope 41%-60% | Slope ≥60% | Slope ≤40% | Slope 41%-60% | Slope ≤60% |
| Light Fuel | Moderate | Moderate | Moderate | Moderate | Moderate | Moderate | Moderate | Moderate | High |
| Medium Fuel | Moderate | Moderate | High | High | High | High | Extreme | Extreme | Extreme |
| Heavy Fuel | High | High | High | High | Extreme | Extreme | Extreme | Extreme | Extreme |

Additional factors that increase fire risk and may be included in a model include lightning and human factors such as the number of persons residing in, camping in, visiting, or traveling through an area. Such persons may increase fire risks through carelessness or ignorance, while other persons (including residents and fire spotters) may reduce risk of uncontrolled wildfire in an area, through their ongoing fire awareness, prevention, and response activities. It also makes sense to take into account the type of fire-fighting personnel, equipment, expertise, and related resources (such as water) that are available to a community, or lacking in adjacent communities (from which a fire might spread).

Vulnerable structures are those located in or near a potential wildfire area, unless they have taken special steps to become "Firewise" (as described previously). Nonflammable roof and patio materials, clearance of vegetation and maintenance of a defensible space around structures, available means to provide and facilitate site access by emergency responders, and so on, will make a structure potentially able to withstand wildfire events in its vicinity. Structures that are located in a wildland/urban interface area should be evaluated for these sorts of site features that will exacerbate or minimize their vulnerability. Certain design or landscaping features can render an at-risk structure completely vulnerable to any nearby wildfire event, and thus should be prioritized for wildfire mitigation strategies.

Although risk-estimation models exist, FEMA has stated that there are no standardized methods for estimating the amount of damages and economic losses that a community will sustain from a wildfire event. Hopefully, a study of the risk assessment options described in this section will enable your community to estimate the frequency of its wildfire events, based on fuel types and weather patterns. Structures in at-risk areas can then be individually assessed according to their "Firewise" characteristics. (These will be rough estimates of vulnerability based on the degree to which wildfire mitigation steps have been used at that site: see the fire protection steps at the FIREWISE web pages at http://www.firewise.org/fw_youcanuse/index.htm.) Structures that are not at all Firewise can be considered at-risk for total losses in a serious wildfire event. Structures that are partly Firewise should be at significantly lowered risk and thus the chances of a total loss should be lower. These estimates can be converted to dollar values (expected annual losses) by using information about housing values, estimates about the value of house contents, the costs of interrupted services, evacuation, road closures, and displacement. The value of total potential losses for each property in an at-risk area should be reduced in proportion to the extent to which it is Firewise. Overall loss calculations will therefore take the average annual occurrence of a fire event in vulnerable areas and multiply it by the percentage of that vulnerable area that will likely be affected (this will have to be estimated based on available wildfire response capabilities, or can be estimated from analyzing the extent of past wildfire events and how difficult they had been to control). The percentage of the vulnerable area affected can be considered to also represent the odds of a particular structure in that area being placed at risk, and so each at-risk structure can then have its value (after being reduced an appropriate percentage that reflects its Firewise characteristics) multiplied by that calculated risk of being involved in a wildfire event. The total of all individual structural losses can then be totaled to estimate an entire community's annual expected losses from wildfires.

The United States Department of Agriculture has created a site with wildfire analysis resources, at http://www.fs.fed.us/fire/science/index.html. Since USDA assesses fire risks nationwide, local or state resources will probably be needed to supplement this source in order to accurately assess a community's specific fuel model areas in your local hazard mitigation plan.

**Wildfire History for Michigan Counties – arranged by region** – Jan. 1996 to Oct. 2013
(The Lower Peninsula regions are ordered by "tiers" from south to north, west to east)
Please refer to the Michigan Profile Map section for an explanation of regional divisions

| COUNTY or area | Wildfire Events | Days with Event | Tot. property damage | Tot. crop damage | Injuries |
|---|---|---|---|---|---|
| Washtenaw | | | | | |
| Wayne | | | | | |
| .Livingston | | | | | |
| Oakland | | | | | |
| Macomb | 2 | 2 | $20,000 | | |
| **5 Co Metro region** | **2** | **2** | **$20,000** | | |
| Berrien | | | | | |
| Cass | | | | | |
| St. Joseph | | | | | |
| Branch | | | | | |
| Hillsdale | | | | | |
| Lenawee | | | | | |
| Monroe | | | | | |
| .Van Buren | | | | | |
| Kalamazoo | | | | | |
| Calhoun | | | | | |
| Jackson | | | | | |
| .Allegan | | | | | |
| Barry | | | | | |
| Eaton | | | | | |
| Ingham | | | | | |
| .Ottawa | | | | | |
| Kent | | | | | |
| Ionia | | | | | |
| Clinton | | | | | |
| Shiawassee | | | | | |
| Genesee | | | | | |
| Lapeer | | | | | |
| St. Clair | | | | | |
| .Muskegon | | | | | |
| Montcalm | | | | | |
| Gratiot | | | | | |
| Saginaw | | | | | |
| Tuscola | 1 | 1 | | | |
| Sanilac | | | | | |
| .Mecosta | | | | | |
| Isabella | | | | | |
| Midland | | | | | |
| Bay | | | | | |
| Huron | | | | | |
| **34 Co S Lower Pen** | **0.3 avg.** | **0.3 avg.** | | | |

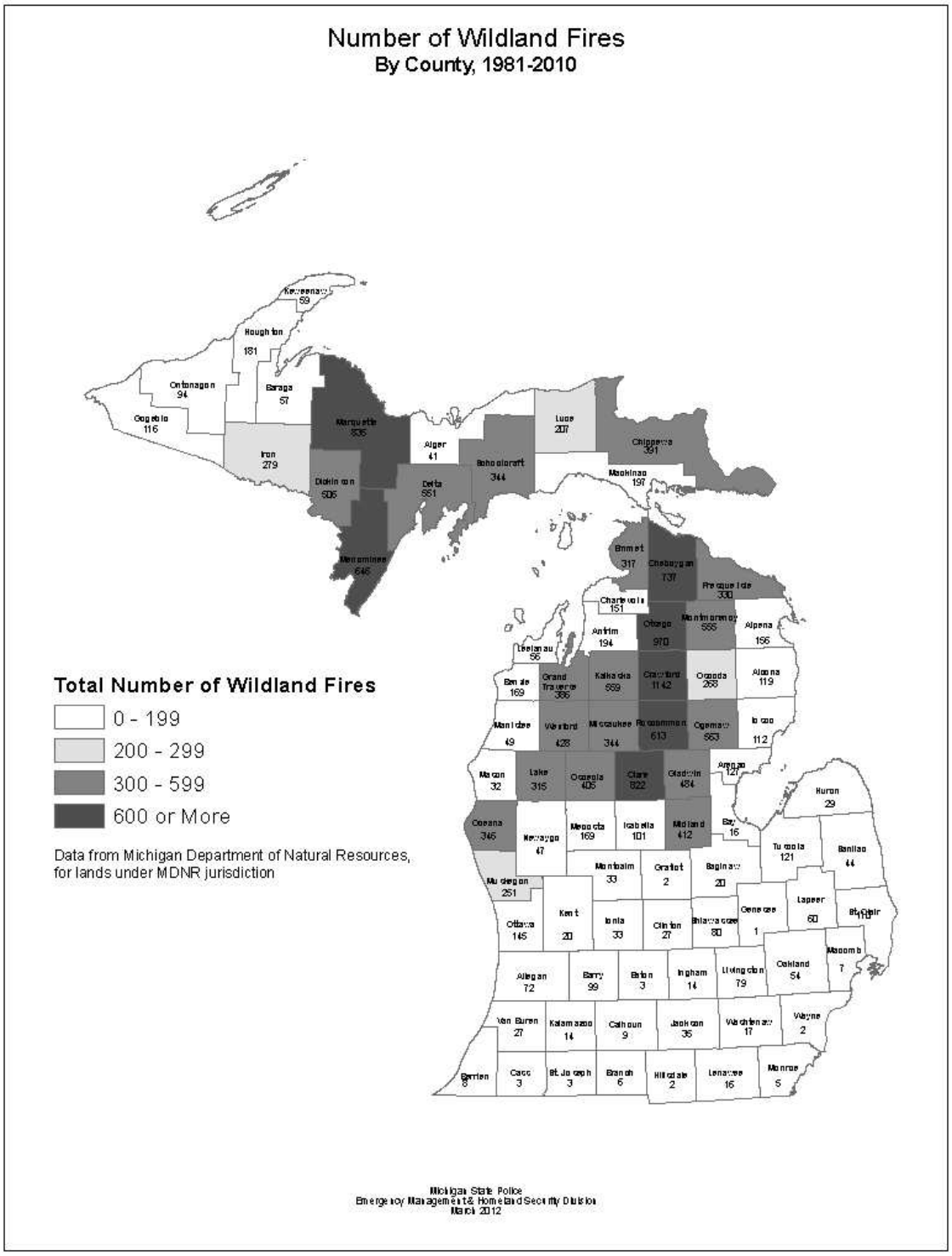
Continued on next page…

**Part 2 of Michigan Counties table**

| | | | | | |
|---|---|---|---|---|---|
| .Oceana | | | | | |
| Newaygo | | | | | |
| .Mason | | | | | |
| Lake | | | | | |
| Osceola | | | | | |
| Clare | | | | | |
| Gladwin | | | | | |
| Arenac | | | | | |
| .Manistee | | | | | |
| Wexford | | | | | |
| Missaukee | | | | | |
| Roscommon | 1 | 1 | | | |
| Ogemaw | | | | | |
| Iosco | 1 | 1 | $40,000 | | |
| .Benzie | | | | | |
| Grand Traverse | | | | | |
| Kalkaska | 1 | 1 | $125,000 | | |
| Crawford | 2 | 2 | $1,575,000 | | |
| Oscoda | 2 | 2 | $600,000 | | |
| Alcona | | | | | |
| .Leelanau | | | | | |
| Antrim | | | | | |
| Otsego | | | | | |
| Montmorency | | | | | |
| Alpena | | | | | |
| .Charlevoix | | | | | |
| Emmet | | | | | |
| Cheboygan | | | | | |
| Presque Isle | | | | | |
| **29 Co N Lower Pn** | **0.2 avg.** | **0.2 avg.** | **$2,340,000** | | |
| Gogebic | | | | | |
| Iron | | | | | |
| Ontonagon | 1 | 1 | | | |
| Houghton | | | | | |
| Keweenaw | | | | | |
| Baraga | 2 | 2 | $50,000 | | |
| .Marquette | 7 | 5 | $5,006,000 | $1,000,000 | 4 |
| Dickinson | | | | | |
| Menominee | | | | | |
| Delta | | | | | |
| Schoolcraft | | | | | |
| Alger | | | | | |
| .Luce | 2 | 2 | $12,040,000 | | |
| Mackinac | | | | | |
| Chippewa | | | | | |
| **15 Co Upp.Pen** | **0.8 avg.** | **0.7 avg.** | **$17,096,000** | **$1,000,000** | **4** |
| **MICHIGAN TOTAL** | **23** | **18** | **$19,456,000** | **$1,000,000** | **4** |

# Number of Wildfires, by County

(MDNR jurisdiction only)



**Number of Wildfires and Acres Burned, by County: 1981-2010** (MDNR jurisdiction only)

| County | Number of Wildfires | Number of Wildfires/Year* (over 30 year period) | Number of Acres Burned | Number of Acres Burned/Year* (over 30 year period) |
|---|---|---|---|---|
| Alcona | 119 | 4 | 843.8 | 28 |
| Alger | 41 | 1 | 123.0 | 4 |
| Allegan | 72 | 2 | 312.0 | 10 |
| Alpena | 156 | 5 | 267.2 | 9 |
| Antrim | 194 | 6 | 194.1 | 6 |
| Arenac | 127 | 4 | 418.8 | 14 |
| Baraga | 57 | 2 | 1897.6 | 63 |
| Barry | 99 | 3 | 447.3 | 15 |
| Bay | 16 | 1 | 142.2 | 5 |
| Benzie | 169 | 6 | 279.3 | 9 |
| Berrien | 8 | 0 | 24.4 | 1 |
| Branch | 6 | 0 | 19.3 | 1 |
| Calhoun | 9 | 0 | 41.2 | 1 |
| Cass | 3 | 0 | 27.0 | 1 |
| Charlevoix | 151 | 5 | 492.3 | 16 |
| Cheboygan | 737 | 25 | 1424.0 | 47 |
| Chippewa | 391 | 13 | 5108.2 | 170 |
| Clare | 822 | 27 | 2385.6 | 80 |
| Clinton | 27 | 1 | 138.9 | 5 |
| Crawford | 1142 | 38 | 25861.5 | 862 |
| Delta | 551 | 18 | 3213.8 | 107 |
| Dickinson | 506 | 17 | 2411.0 | 80 |
| Eaton | 3 | 0 | 0.3 | 0 |
| Emmet | 317 | 11 | 543.5 | 18 |
| Genesee | 1 | 0 | 0.1 | 0 |
| Gladwin | 484 | 16 | 1938.9 | 65 |
| Gogebic | 116 | 4 | 245.4 | 8 |
| Grand Traverse | 386 | 13 | 1296.9 | 43 |
| Gratiot | 2 | 0 | 40.0 | 1 |
| Hillsdale | 2 | 0 | 23.0 | 1 |
| Houghton | 181 | 6 | 1200.1 | 40 |
| Huron | 29 | 1 | 725.5 | 24 |
| Ingham | 14 | 0 | 474.7 | 16 |
| Ionia | 33 | 1 | 728.4 | 24 |
| Iosco | 112 | 4 | 1630.3 | 54 |
| Iron | 279 | 9 | 1953.9 | 65 |
| Isabella | 101 | 3 | 931.8 | 31 |
| Jackson | 35 | 1 | 520.5 | 17 |
| Kalamazoo | 14 | 0 | 74.3 | 2 |
| Kalkaska | 559 | 19 | 2953.4 | 98 |
| Kent | 20 | 1 | 125.9 | 4 |
| Keweenaw | 59 | 2 | 375.6 | 13 |
| Lake | 315 | 11 | 1283.5 | 43 |
| Lapeer | 60 | 2 | 533.8 | 18 |
| Leelanau | 56 | 2 | 212.0 | 7 |
| Lenawee | 16 | 1 | 224.2 | 7 |
| Livingston | 79 | 3 | 651.4 | 22 |
| Luce | 207 | 7 | 18679.9 | 623 |
| Mackinac | 197 | 7 | 1610.6 | 54 |
| Macomb | 7 | 0 | 15.4 | 1 |
| Manistee | 49 | 2 | 1041.6 | 35 |
| Marquette | 835 | 28 | 16087.6 | 536 |
| Mason | 32 | 1 | 154.6 | 5 |
| Mecosta | 169 | 6 | 844.9 | 28 |
| Menominee | 646 | 22 | 2353.4 | 78 |
| Midland | 412 | 14 | 1414.9 | 47 |
| Missaukee | 344 | 11 | 1772.0 | 59 |
| Monroe | 5 | 0 | 233.3 | 8 |
| Montcalm | 33 | 1 | 567.6 | 19 |
| Montmorency | 555 | 19 | 1271.5 | 42 |
| Muskegon | 251 | 8 | 2675.7 | 89 |
| Newaygo | 47 | 2 | 404.2 | 13 |
| Oakland | 54 | 2 | 368.5 | 12 |
| Oceana | 346 | 12 | 1766.0 | 59 |
| Ogemaw | 563 | 19 | 8296.1 | 277 |
| Ontonagon | 94 | 3 | 1438.1 | 48 |
| Osceola | 405 | 14 | 1085.2 | 36 |
| Oscoda | 268 | 9 | 8765.3 | 292 |
| Otsego | 970 | 32 | 1924.9 | 64 |
| Ottawa | 145 | 5 | 469.9 | 16 |
| Presque Isle | 330 | 11 | 838.4 | 28 |
| Roscommon | 613 | 20 | 4551.9 | 152 |
| Saginaw | 20 | 1 | 474.7 | 16 |
| Sanilac | 44 | 1 | 427.3 | 14 |
| Schoolcraft | 344 | 11 | 3210.5 | 107 |
| Shiawassee | 80 | 3 | 576.7 | 19 |
| St. Clair | 110 | 4 | 1642.8 | 55 |
| St. Joseph | 3 | 0 | 7.7 | 0 |
| Tuscola | 121 | 4 | 930.9 | 31 |
| Van Buren | 27 | 1 | 249.2 | 8 |
| Washtenaw | 17 | 1 | 217.5 | 7 |
| Wayne | 2 | 0 | 42.2 | 1 |
| Wexford | 428 | 14 | 1057.4 | 35 |
| Total DNR fire events | 17449 | 582 | 152228.3 | 5074 |

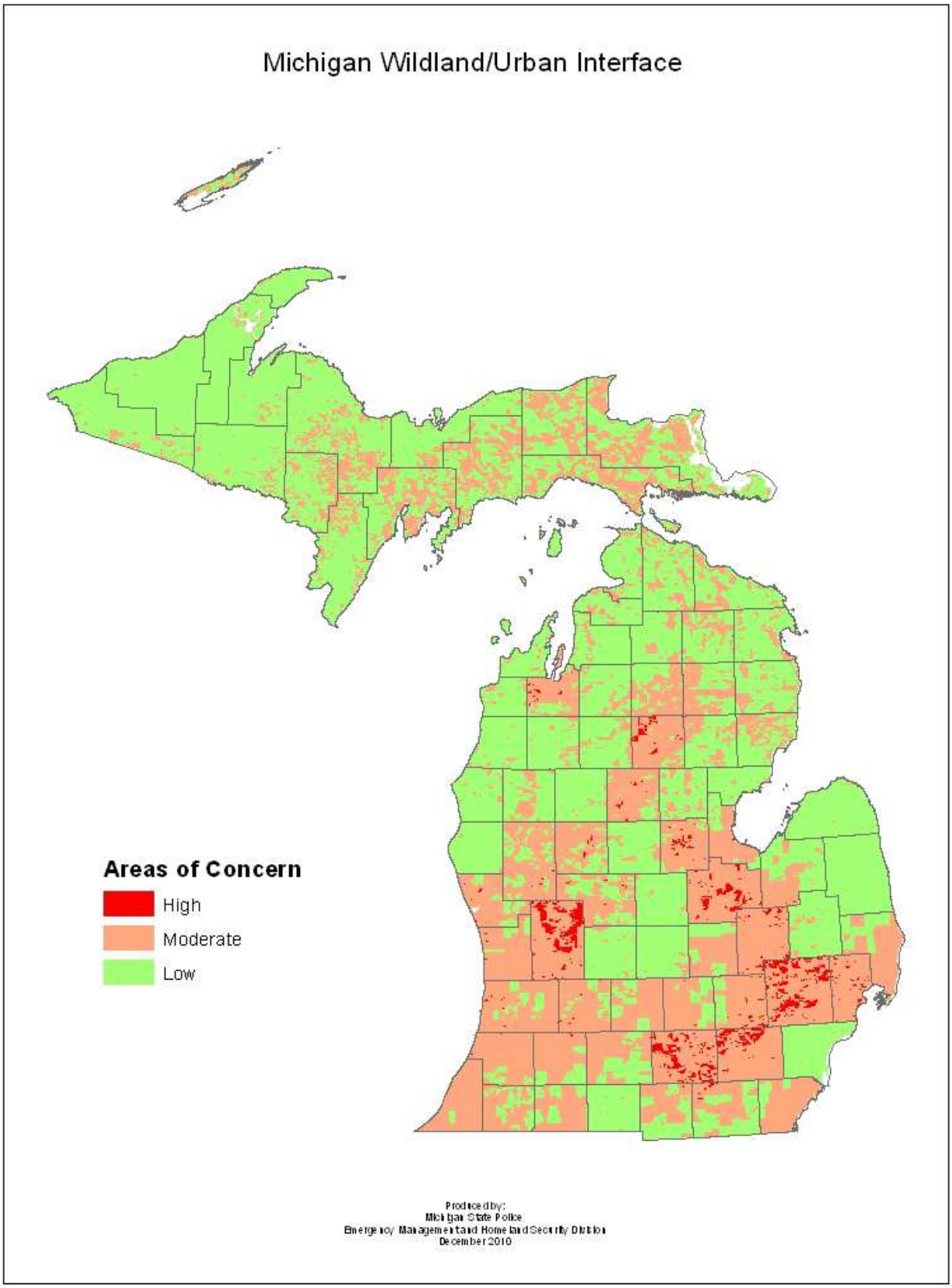
*rounded to nearest whole number

Source: Michigan Department of Natural Resources—Forest Management Division

## Michigan Wildland/Urban Interface Map

Source: Michigan Department of Natural Resources, Forest Management Division

**NOTE: This map is an example from a previous analysis and is being updated by more valid GIS modeling - not recommended for current use except as a highly generalized indicator**



# INVASIVE SPECIES

*A species that has been introduced by human action to a location where it did not previously occur naturally, becomes capable of establishing a breeding population in the new location without further intervention by humans, and becomes a pest by threatening local biodiversity and causing human health impacts, significant economic costs, and/or harmful ecological effects.*

***Hazard Description***

An invasive species is defined as a species that is (1) non-native (alien) to the ecosystem under consideration and (2) whose introduction causes or is likely to cause economic or environmental harm, or harm to human health. Invasive species can be plants, animals, and other organisms (e.g., microbes). Human actions are the primary consideration here as a means of invasive species' introduction (thus distinguishing the situation from natural shifts in the distribution of species). Nationally, the current environmental, economic, and health costs of invasive species were estimated as exceeding the costs of all other natural disasters combined.

Invasive species can be transported in many ways, such as on animals, vehicles, ships, commercial goods, produce, and clothing. Although non-native species are the foundation of U.S. agriculture, and also are used to prevent erosion, to provide fishing and hunting opportunities, and as ornamental plants and pets, occasionally a non-native organism flourishes too well and causes unwanted economic, ecological, or human health impacts. The terms "invasive" or "nuisance" are used to describe such species. New environments may affect rates of reproduction, susceptibility to disease, and other features that affect a species' success. Consequently, a plant or animal that causes little damage to agriculture or natural ecosystems in one area may cause significant problems in another. Certain non-native species are very successful in their new habitats because they out-compete native plants or animals and have no natural controls (predators, diseases, etc.) in the new area. At least 200 well-known, high-impact, non-native species presently occur in the United States. They range from the European gypsy moth and emerald ash borer to crabgrass, dandelions, and German cockroaches, annually costing well over a billion dollars to control. Some even pose human health risks. Others, like the zebra mussel, threaten widespread disruption of ecosystems and the displacement or loss of native plants and animals.

***Hazard Analysis***

Hundreds of new species from other countries are introduced intentionally or accidentally into the United States each year. These invasive species may arrive on our shores in a variety of ways. Transportation efficiencies that make it possible to travel around the globe in hours rather than weeks make it possible for organisms to survive transportation from one continent to another

As more adaptable and generalized species are introduced to environments already impacted adversely by human activities, native species are often at a disadvantage to survive in what was previously a balanced ecosystem. There are many examples of decreased biodiversity in such areas. One of the primary threats to biodiversity is the spread of humanity into what were once isolated areas, with land clearance and habitation putting significant pressure on local species. Agriculture, livestock, and fishing can also introduce changes to local populations of indigenous species and may result in a previously innocuous native species becoming a pest, due to a reduction of natural predators. This threat intensifies the need for scientists, managers, and stakeholders to cooperate to build better systems to prevent invasion, improve early detection of invaders, track established invaders, and to coordinate containment, control, and effective habitat restoration.

Although invasive species, in most cases, primarily cause environmental damage and degradation, there are situations in which serious threats to public health, safety, and well-being can occur due to animal disease or plant/animal infestations. For example, certain diseases could wipe out large segments of an animal population, creating a potentially serious public health emergency and the need to properly (and rapidly) dispose of the dead animal carcasses.

Similarly, a widespread insect infestation, such as that of the Emerald Ash Borer, can create serious public safety threats (especially in densely populated urban areas) due to dead and dying trees being fire prone (because of their

dry, brittle nature) or to partial/total collapse due to high winds or ice/snow accumulation. The falling trees or limbs can also bring down power lines, cause damage to public and private structures, and cause injuries or even death.

The invasive species hazard has not yet been identified as one of the most significant hazards in any of Michigan's local hazard mitigation plans.

Impact on the Public
The emerald ash borer has caused extensive damage to trees in Michigan, and those weakened trees have often (1) collapsed and caused property damage, or (2) required removal, at considerable expense. A disaster declaration request was sent to FEMA, but the request was not accepted by that agency, leaving state and local budgets, residents, and insurance companies to try to cover the considerable expenses and efforts involved in dealing with the problem. Similar terrestrial species include the Asian Long-Horned Beetle and the Cedar Long-Horned Beetle, although aquatic species and some microbes are also of concern, since they may disrupt or impede forestry, horticulture, and fishing for Michigan residents, tourists, and industries.

Impact on Public Confidence in State Governance
Terrestrial species are likely to have more general public awareness than aquatic ones, and thus more likely to be a cause for dissatisfaction or loss of public confidence in government. Although there have been well-publicized aquatic species of concern (e.g. zebra mussels, Asian carp), people tend to be more aware of the impacts of terrestrial species, unless their recreational or business activities are more heavily curtailed by aquatic ones. The most recent widespread terrestrial species of concern has been the emerald ash borer insect—trees killed by these insects are prone to collapse, causing property damage, blocked roads, broken utility lines, etc. Citizens and businesses that are more heavily connected with agriculture and tourist industries are more likely to be aware of the impact of invasive species, and thus more likely to express doubts about government policies.

Impact on Responders
The invasive species hazard is a less familiar one for the general public, generally long-term and insidious in its effects, and rooted in an understanding of the biological sciences. Most emergency management training does not focus on the topic. Emergency management consideration of invasive species is recent and therefore needs to be increased. MSP/EMHSD has recently been strengthening coordination with the U.S. Geological Survey, which has specialized offices dealing with this hazard. An Ann Arbor USGS office deals with Great Lakes aquatic species, and a separate USGS office in Fort Collins, Colorado, deals with terrestrial species. Information and resources derived from this coordination will be made available to emergency management partners, and should be promulgated through the next update of the Michigan Hazard Analysis.

Impact on the Environment
Terrestrial and aquatic forms of invasive species both pose problems for the ecosystems in which they are introduced. Whether invasive species are brought to an area on purpose or by accident, these non-native life forms can alter the existing ecosystem and decrease an area's biodiversity. Like many hazards that affect Michigan's environment, invasive species have both direct and indirect impacts. The Zebra Mussel, for example, has been invading Michigan's water bodies since the mid 1980's and is responsible for eating the microscopic food supply that is vital to the existing ecosystem. Further, the Zebra Mussel attaches to water intake pipes and screens used for drinking water and industrial plants. Not only do these pests cause environmental problems, but they cause secondary economic impacts to a community as well. Similarly, the Emerald Ash Borer, a non-native insect, is responsible for killing millions of Ash Trees in Michigan, which changes the biodiversity of the forest and diminishes wildlife habitats. Dead trees pose problems for the human-built environment, as well, pulling down nearby wires and damaging structures.

***Climate Change Considerations***
Different patterns of wildlife have already been concerned as a result of the lengthening average growing season in Michigan. Species that had previously been found only in warmer areas to the south have started to appear in Michigan. Although the definition of invasive species specifically refers to human species introduction, to distinguish these patterns from naturally occurring ones, species transported by human action can be more likely to survive (and thus to become invasive) as climatic changes occur.

**NOTE: The following lists and descriptions provide examples of invasive species that pose some threat to Michigan, or have already affected Michigan. For each of these categories, at least several other species could have been included. Some of these species, such as the Gypsy Moth, are already well-established throughout the state, but the text provides information about the kinds of impacts that can result from the invasive species hazard.**

Much additional information can be found at http://www.invasive.org/ and http://web4.msue.msu.edu/mnfi/.

## Examples of Potentially Threatening Invasive Insects
## (Note: Not all of these species currently occur in Michigan.)

**Balsam Woolly Adelgid (Adelges piceae)**
**Hosts:** All true firs.
**Symptoms:** Small white masses on tree, stunted shoots, formation of galls, tree crown turns red.
**Damage:** Feeding on the branches of the crown and main stem, causing mortality in 2-6 years.
**Control/Treatment:** Spraying of individual trees from the ground with lindane has proved effective for control. The spray, prepared by mixing 2.5 pints of 10% emulsifiable concentrate per 100 gallons of water, is applied as a bark drench with a hydraulic sprayer from May through June and September through October to control crawlers. Treatment will reduce populations to below the tree-killing level, and some treated trees may remain generally free from aphids for at least 2 years. Spraying is warranted only in accessible areas supporting relatively high-value trees.

**Hemlock Woolly Adelgid (Adelges tsugae)**
**Hosts:** Eastern Hemlocks.
**Symptoms:** Small white cottony masses at the base of the needles. Needles turn grayish green and drop off. There is a lack of new buds, and low vigor.
**Damage:** Feeding on twigs by nymphs cause the trees to die within 1-4 years.
**Control/Treatment:** Horticulture oils that smother the insects have been the best insecticidal treatment. The oils are non-toxic to the trees, as opposed to soap, which is an otherwise effective treatment. However, the least harmful cure may be the introduction of Japanese ladybugs.

**Asian Long-Horned Beetle (Anoplophora glabripennis)**
**Hosts:** Several species of hardwood trees found in Michigan. Its favorite host is the Norway maple, although it has been found in other maple species, horse chestnut, elm, box elder, mulberry and poplar trees.
**Symptoms:** Dark, wet areas on branches and trunks or white foamy sap are often the first symptoms seen in infested trees. The sap often attracts bees, wasps and hornets.
**Damage:** Trees infested are first weakened, and then die. Damage from these insects and secondary pests will kill a tree within a few years.
**Control/Treatment:** The only known way to eradicate the beetle is to cut down and burn infested trees.

**Japanese Cedar Long-Horned Beetles (Callidiellum rufipenne)**
**Hosts:** Nest in white cedar, eastern red cedar, and cypress trees.
**Symptoms:** Oval exit holes on tree bark, or deep irregular galleries in wood.
**Damage:** Larvae bore into wood and weaken the tree. Heavily infested trees may die.
**Control/Treatment:** None at this time.

**Emerald Ash Borer (EAB) (Agrilus planipennis)**
**Hosts:** White, black, and green ash trees.
**Symptoms:** Typically the upper third of a tree will die back first, followed by the rest during the next year. This is often followed by a large number of shoots or sprouts arising below the dead portions of the trunk. The adult beetles typically make a D-shaped exit hole when they emerge. Tissue produced by the tree in response to larval feeding may also cause vertical splits to occur in the bark. Distinct S-shaped tunnels may also be apparent under the bark. Adults are dark metallic green in color, 1/2 inch in length and 1/16 to 1/8 of an inch wide and are only present from mid May until late July. Larvae are creamy white in color and are found under the bark.
**Damage:** The adult beetles feed on ash foliage but cause little damage. The larvae feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients. Many trees appear to lose about 30 to 50 percent of their canopy in one year and the tree is often killed after 2-3 years of infestation. Most of the devastation in Michigan has occurred in the southeastern Lower Peninsula, where about 20 million trees have been killed. Fallen trees have caused extensive property damage. Please refer to the map at the end of this section for information about EAB quarantine areas in Michigan.
**Control/Treatment:** Treatment options for controlling infected or at risk trees include systemic insecticides applied as soil injections, systemic insecticides applied as trunk injections, noninvasive systemic sprays, and protective cover sprays. If properly applied, these treatment options can prevent EAB larvae from taking over the ash tree about 70% of the time. Treatment also proves to be successful when managing at-risk trees in areas where EAB has been identified. In continuing efforts to halt the expansion of the EAB, the Michigan Department of Agriculture and Rural Development (MDARD) has placed restrictions on the movement of firewood throughout the state and has taken other appropriate response measures. More information on the EAB can be found on the MDARD's website: www.michigan.gov/eab.

**Gypsy Moth (Lymantria dispar)**
**Hosts:** Tree foliage.
**Symptoms:** The egg mass is usually laid within a few feet of the female pupa casing. They are covered by a dense coating of hairs.

**Damage:** During high population levels, total defoliation can occur. During the months of June and July, defoliating populations cover sidewalks, homes, children's play equipment and other objects, making outdoor activity in residential and recreational areas almost impossible. For Michigan's nursery industry, additional expense and pesticide use are required. For the forest products industry, high gypsy moth populations mean the potential loss of wood fiber from reduced production (due to tree stress or mortality).
**Control/Treatment:** Counties may get involved in the Michigan Cooperative Suppression Program. The only pesticide used in the Cooperative Suppression Program is Bacillus thuringiensis, most commonly referred to as Bt.

**Khapra Beetle (Trogoderma granarium)**
**Hosts:** The beetle prefers hot, dry conditions and can be found in areas where grain and other potential food is stored, such as pantries, malt-houses, grain and fodder processing plants, and stores of used grain sacks or crates.
**Symptoms:** Destruction of grains and seeds. They can multiple quickly in stored items such as crackers, wheat, flour and baby cereal and rapidly spread to warehouses, storage bins, and mills.
**Damage:** The beetles can potentially cause severe harm to the agriculture crop industry such as grains and seeds including wheat, soybean, barley, corn and rice.
**Control/Treatment:** Fumigation with methyl bromide in containers to quarantining shipments until treatment. Powdered neem has been used to control the beetle in wheat stores in India.

**Common Pine Shoot Beetle (Tomicus piniperda)**
**Note: Although previously listed in the Michigan Hazard Analysis, this species is no longer considered as damaging as it originally had been when first discovered in Michigan during the 1980s. The insect is now widespread throughout the Great Lakes and currently causes little economic impact.**


Some invasive insects in Michigan, from left to right: Asian long-horned beetle, cedar long-horned beetle, emerald ash borer, gypsy moth

## Examples of Potentially Invasive Microbes

(NOTE: Sudden Oak Death was described in previous editions of this plan, but has only occurred in California and Oregon. Examples listed here are not necessarily found in Michigan at the present time.)

At left, Dutch elm disease; at right, the plum pox virus

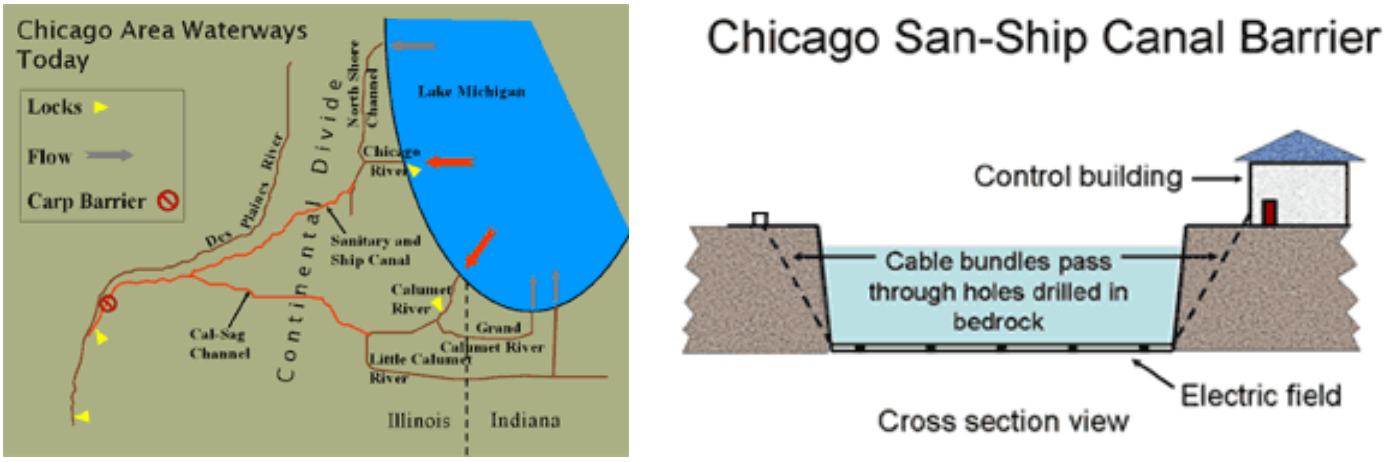
**Dutch Elm Disease**
**Hosts:** Elm trees
**Symptoms:** Trees infected by elm bark beetles first show wilting, curling, and yellowing of leaves on one or more branches in the upper portion of the tree, as a fungus from the beetles progressively affects the tree's health.
**Damage:** Large trees may survive and show progressively more symptoms for one or more years. Trees infected through root grafts wilt and die rapidly; this frequently occurs in the spring, soon after the trees have leafed out, and progresses from the base of the tree upward.
**Control/Treatment:** Dutch elm disease control has involved two different but related programs: (1) community-wide sanitation programs designed to reduce the level of elm bark beetles (principal carriers of the Dutch elm disease fungus); and (2) prevention of the spread of the disease through natural root grafts from infected trees to adjacent healthy trees. There are probably no community-wide programs being used any more, with a shift toward disease management involving the planting of different species of trees. There is no way to eliminate Dutch elm disease once it begins, but different species such as Siberian elms are resistant to the disease.

**Plum Pox Virus**
**Hosts:** Peach, plum, nectarine, apricot, almond, cherry.
**Symptoms:** Discolored viral rings on leaves and fruit.
**Damage:** Smaller deformed fruit and reduced fruit production.
**Control/Treatment:** Control and prevention measures include field surveys, use of certified nursery materials, use of virus-resistant plants (when available), control of aphids, and the elimination of infected trees in nurseries and orchards. A team of scientists from the United States and France has genetically engineered a PPV-resistant plum (known as C5), and this resistance can be transferred through hybridization to other plum trees. This provides a source of germplasm for future breeding programs worldwide. Similar success has not yet occurred in attempts to genetically modify other Prunus species.

**Thousand Canker Disease of Walnut**
**Hosts:** Black walnut and other walnut species.
**Symptoms:** Infected trees show wilting, curling, and yellowing of leaves on one or more branches in their upper portions, as a fungus from the walnut twig beetles progressively affects the tree's health.
**Damage:** Causes thousands of small cankers on and under the bark, disrupting the flow of nutrients to the branches. Tree mortality is directly proportional to the number of feeding sites present on the tree.
**Control/Treatment:** There is no practical treatment, once infected. Landowners should remove affected trees to prevent spread to nearby trees.

## Examples of Invasive Water Species Affecting Michigan

**Asian Carp (Ctenopharyngodon idella, hypophthalmichthys nobilis, and hypophthalmichthys molitrix)**
**Hosts:** Asian carp made their way into the Mississippi River from Arkansas fish farms in the 1970s as a result of flooding and have steadily swum upstream for years at a pace of 40 to 50 miles a year. Asian carp are currently in the Illinois River and only miles away from entering the Great Lakes.
**Symptoms:** Decline in native fish species**.** There are three different species of Asian carp that have invaded the Mississippi River: grass (ctenopharyngodon idella), bighead (hypophthalmichthys nobilis), and silver (hypophthalmichthys molitrix). All three species of Asian carp pose a problem to the waterways by devastating habitats and destroying water quality. However, the bighead and silver carp are of the greatest concern, due to their size. These fish can each grow to be 50 to 100 pounds. Although great attention has been focused on these fish recently, dreissenid mussels have already invaded the Great Lakes and caused extensive impacts. (A description of mussels also appears in this section.)
**Damage:** Researchers expect that Asian carp would disrupt the food chain that supports the native fish of the Great Lakes. Due to their large size, ravenous appetites, and rapid rate of reproduction, these fish could pose a significant risk to the Great Lakes Ecosystem. If bighead or silver carp enter the great lakes, the economic impacts on the fishing industry would be devastating, putting the Midwest's multi-billion dollar-a-year fishing industry at risk. Also, silver carp have been known to cause injuries to boaters, as they jump out of the water.
**Control/Treatment:** To prevent the species from entering the Great Lakes, the U.S. Army Corps of Engineers, U.S. EPA, State of Illinois, International Joint Commission, Great Lakes Fishery Commission, and U.S. Fish and Wildlife Service constructed a temporary electronic dispersal barrier on the Chicago Sanitary and Ship Canal near Romeoville, Illinois, which was activated in April, 2002. In late October 2004, construction began on a second, more permanent barrier. The new barrier, completed in February 2005, stretches two rows of electrodes across the canal approximately 220 feet apart. The electrodes pulse DC current into the water, causing fish to turn back rather than pass through the electric current. The electric current poses no threat to humans. A model of the Chicago Canal Barrier can be seen below.
In November 2009, evidence of the presence of Asian carp was detected beyond the electric barrier, which left only a single lock/dam on the Calumet River between the carp's detected location and Lake Michigan. Due to the major ecological threat to Lake Michigan and to recreational boaters, the U.S. Army Corps of Engineers shut down one of the electric barriers for maintenance in December 2009. The Illinois Department of Natural Resources responded to the situation by dumping 2,200 gallons of the toxin rotenone into the canal. Rotenone is deadly for fish but not harmful to humans, animals, or most other aquatic life. The intentional fish kill cost $3 million and produced about 90 total tons of dead fish, but only one carp was found in the Lockport Lock and Dam area. In June 2010, a 19-pound Asian carp was found near the shore of Lake Michigan, in Lake Calumet, about six miles downstream from Lake Michigan, by a commercial fisherman hired by the state of Illinois to do routine fish sampling in the area. The fish confirmed existing DNA evidence suggesting that the Asian carp had indeed breached the electric barrier on the Chicago Sanitary and Ship Canal, which had been considered the last line of defense for Lake Michigan. One type of Asian Carp was recently found within the Great Lakes watershed area, but as grass carp, it was not of the type whose impact is of such widespread concern.



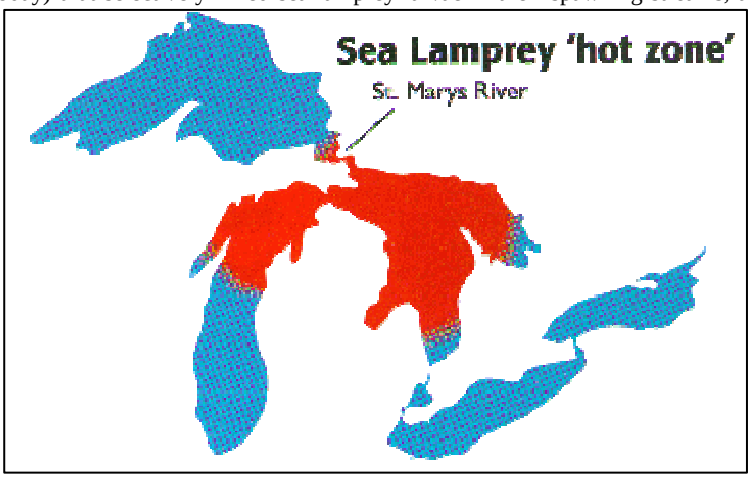

Chicago Sanitary and Ship Canal Dispersal Barrier System (Source: U.S. Geological Survey)

**Sea Lamprey (Petromyzon marinus)**
**Hosts:** Found in both fresh water and salt water habitats, they breed in freshwater streams and lakes and were first discovered in the Great Lakes in the 1800s.
**Symptoms:** Sea lampreys prey on a wide variety of fish. The lamprey uses its suction-cup like mouth to attach itself to the skin of a fish (possibly for days) and rasps away tissue with its sharp probing tongue and many hooked teeth, arranged in numerous rows. Secretions in the

lamprey's mouth prevent the victim's blood from clotting, and the lamprey sucks the victim's blood. Victims (usually smaller ones) typically die from excessive blood loss or infection. Mature sea lampreys average 2 to 2½ feet long, up to a maximum of about 3 feet. Sea lampreys are considered a pest in the Great Lakes region and were introduced as an invasive species in the 1800s, originating from the inland Finger Lakes and Lake Champlain in New York and Vermont. Sea lampreys created a problem for key predator fish species including lake trout, lake white fish, and lake herring. The elimination of these key predator fish allowed the alewife, another invasive species, to explode in population, having adverse effects on many native fish species.

**Damage:** The introduction of the sea lamprey to Lake Superior caused serious declines in fish populations, and an alteration of the ecosystem. The lake trout played a vital role in the Lake Superior ecosystem because it is considered an apex predator, which means that the entire system relies on its presence to be diverse and healthy. As an apex predator was removed from the system, the entire system felt the effects all the way down the food chain. The sea lamprey is an aggressive predator by its nature, which gives it a competitive advantage in a lake system where it has no predators and its prey lack defenses against it. The sea lamprey played a large role in the drastic decline of the Lake Superior lake trout population. One sea lamprey can upset an ecosystem and food chain by eating an estimated 40 pounds of fish or more in its lifetime. This resulted in an unbalanced relationship between predators and prey in the Great Lakes' Ecosystem.

**Control/Treatment:** Control efforts to mitigate the destructive effects of the sea lamprey have included the use of electric currents, chemicals, and barriers. In 1958, scientists found a chemical (still used today) that selectively killed sea lamprey larvae in their spawning streams, and brought the lamprey under control. In 1986, DNR fish managers, technicians and engineers designed a new lamprey barrier which let fish migrate through to spawn, but captured the lamprey. The new barrier was expected to reduce the number of lamprey beyond it to nearly zero. Lamprey numbers in Lake Michigan are currently only about 10 percent of their peak numbers in the 1950s. Today, biologists and researchers are still looking for new ways to stop the spread of lampreys in lakes, streams, and rivers. It is the hope of the Great Lakes Fishery Commission that at least some of this scientific work on the sea lamprey, including genetic and pheromone studies, will result in a more effective management technique that could one day drastically reduce the need for chemical treatments of spawning grounds. Several million dollars are spent each year on environmentally friendly control methods. Native predatory fish, like the whitefish and lake trout, have been restocked by fisheries professionals to help maintain a healthy level of these species.




**<u>Dreissenid Mussels (including Zebra Mussels and Quagga Mussels)</u> (family Dreissenidae)**

**Hosts:** Freshwater lakes and streams

**Symptoms:** By firmly attaching to hard surfaces, dreissenid mussels have clogged water-intake pipes and fouled hard-shelled animals such as clams and snails. In addition, zebra mussels have reduced plankton populations, as colonies of mussels filter large volumes of water for food, potentially depleting food resources of larval and planktivorous fishes such as smelt, chub, and alewife. Transfer of suspended material to the lake bottom in mussel waste products also leads to increased water clarity and increased growth of aquatic plants. Although clear water is often considered aesthetically pleasing, this clarity indicates that drastic changes have occurred at the base of the food web and that energy flows through the ecosystem has been altered. The mass media has given a great deal of attention to the zebra mussel, but quagga mussel infestations are actually far more extensive in the Great Lakes. Both zebra and quagga mussels belong to the same genus, dreissenid mussels, but quagga mussels are more tolerant of colder and deeper waters than zebra mussels are. Quagga mussels were first spotted in the Great Lakes around 1990, and have devoured so much plankton that the food web is being altered.

**Damage:** Communities along the affected lakes and rivers rely on these waters for drinking, industrial water supplies, transportation, commercial fishing and shelling, and recreation. Rapidly expanding populations of dreissenid mussels could ultimately affect many of these activities, in addition to changing the structure of the ecosystem.

**Control/Treatment:** Applications of hot water and bleach have been used. A new method involving bacteria is being refined.


A couple of invasive aquatic species: Asian carp and zebra mussel.

## Invasive Plant Species in Michigan

Please refer to the information in the MDNR publication "Meeting the Challenge of Invasive Plants: A Framework for Action," which can be found at the following website:

http://www.michigan.gov/documents/dnr/Invasives_strategy_final_289799_7.pdf. Numerous online resources provide more information about plants, such as the NRCS database at http://plants.usda.gov/java/.

### Example of a Terrestrial Animal Species that Poses a Threat to Michigan

**Boar or Wild Hogs (Sus scrofa)**

Feral swine are defined as free-ranging pigs and are considered to be an aggressive public nuisance. They have been known to attack and chase humans. They can become infected with, and may transmit, diseases that affect human health, domestic livestock, and wildlife, such as brucellosis, tuberculosis, bubonic plague, tularemia, anthrax, and trichinosis. In Michigan, pseudorabies-positive feral swine were removed from private land in 2008. Feral swine have the potential to cause great economic harm to the domestic swine industry, if they were to transmit such disease to commercial swine.

The appearance of feral swine may vary greatly, as they can originate from several subspecies, including the Russian Boar, the wild Eurasian boar, escaped domestic swine, and quite often a mix of domestic and wild-type breeds. These animals can weigh up to 400 pounds, may be covered in coarse hair, may have tusks, and are known to travel in groups. Females in warm states produce two large litters of 8 to 10 piglets per year. In Michigan, feral swine are known to survive the harsh winters. Feral swine tend to follow creeks and drains between food sources. They favor agricultural crops, but when the crops are harvested in the fall, they turn to wildlife food plots, acorns, and other mast foods. Feral swine are known to eat ground nesting birds, small mammals, and grubs.

**Damage:** Feral swine can tear up the landscape, killing wildlife and pets, damaging farm crops and wildlife habitats, and scavenging uncovered garbage. Their devastating effect on crops accounts for up to $1.5 billion in annual damages nationally. Unlike most animals, feral swine don't stop at just eating crops. They also root holes in the ground as deep as a foot, destroying the crops. Wild hogs can damage as much as 10 percent of a farmer's crop.

To date, the Department of Natural Resources has logged 288 unofficial feral swine sightings by residents in almost every county in Michigan. Since 1999, national experts have estimated that, if unchecked, the feral swine population could become established statewide and cause economic hardship for farmers, and for businesses that cater to wildlife enthusiasts.

**Control:** On May 13, 2010, the Michigan Legislature amended Public Act 328 of 1976 (Domestic Animals Running at Large) by allowing people to pursue and harvest feral swine at any time. The law does the following: (1) declares swine running at large on public or private property to be a public nuisance, (2) permits a local animal control officer or a law enforcement officer to kill swine running at large on public or private property, (3) permits a person with a concealed weapon permit or a valid hunting license to kill swine running at large on public property, and (4) permits a property owner or other authorized person to kill swine running at large on private property. In the last case, the landowner does not need a hunting license.

Michigan residents who see or shoot a feral pig are asked to report it to the Michigan Department of Natural Resources at (517) 336-5030. USDA Wildlife Services (517-336-1928) and the Wildlife Conservancy (517-641-7677) have feral swine traps available for the use of landowners who are experiencing feral swine damage. The animals will be trapped, removed, and tested for disease, then euthanized and disposed of.

In December, 2010, the Michigan Department of Natural Resources classified feral swine as an invasive, exotic or prohibited species under Public Act 451, the state's Natural Resources and Environmental Protection Act of 1994, but the Director's order does not go into effect until April of 2011.

**Partners:** The Feral Swine Working Group is an interagency team of veterinarians, biologists, and policy personnel within the state and federal governments, Michigan State University, and from numerous stakeholder groups, including the Michigan Animal Control Association, Michigan Farm Bureau, Michigan Pork Producers Association, Michigan United Conservation Clubs, Michigan Corn Growers Association, the Nature Conservancy, United Deer Farmers of Michigan, the Michigan Hunting Dog Federation, and the Michigan Wildlife Conservancy.

## Animal Diseases

There are many animal diseases that have the potential to impact Michigan. Diseases from outside Michigan or the United States have the potential to cause widespread mortality in livestock, wildlife, and companion animals. They could result in huge economic losses (primarily through trade restrictions), require significant resources to be allocated for response, and in some cases could also threaten public health. For more information, please refer to the Reportable Animal Diseases documents of the Department of Agriculture and Rural Development. (One introductory link is: http://www.michigan.gov/mda/0,1607,7-125-48096_48097_48155-71720--,00.html.) Foot and Mouth Disease is an example of a foreign animal disease that would require a heightened response from Michigan agencies.

### Example of a Livestock Disease That Poses a Threat to Michigan

**Foot and Mouth Disease**

**Hosts:** This infectious virus spreads on surfaces and in the air, and impacts cattle, swine, sheep, goats, deer, and other cloven-hoof ruminant animals. It does not currently exist in Michigan or the United States and has not existed in the U.S. since 1929. However, the disease is of great concern because it is highly contagious and would have grave economic consequences for Michigan's livestock industry.

**Symptoms:** In cattle, blisters inside the mouth that lead to excessive secretion of stringy or foamy saliva and to drooling; and blisters on the feet that may rupture and cause lameness. Adult animals may suffer weight loss from which they do not recover for several months, as well as swelling in the testicles of mature males. In cows, milk production can decline significantly.

**Damage:** Though most animals eventually recover from FMD, the disease can lead to myocarditis (inflammation of the heart muscle) and death, especially in newborn animals. Some infected animals do not suffer from or show signs of the disease, but they are carriers of FMD and can transmit it to others.

**Control/Treatment:** The Michigan Department of Agriculture and Rural Development (MDARD) licenses and regulates Michigan's 500 livestock dealers, truckers, livestock sales, and auction markets to help monitor animal health and ensure the safe and humane handling of

animals. The MDARD also monitors and controls the interstate and intrastate shipment of animals and animal products, to eradicate and control the spread of disease. If this disease were discovered in the United States, it would trigger national and state response plans and require rapid and coordinated response in order to control the disease and protect the nation's livestock industry.

### Wildlife Diseases that Pose a Threat to Michigan

**Chronic Wasting Disease (CWD)**

This is a prion disease of the brain. The infectious agent contaminates the environment and is transmitted from one animal to another.

**Hosts:** Deer and elk are affected by this brain disease that is present in several western states and in Minnesota and Wisconsin. It was also detected in one Michigan location in 2008 (at an enclosed deer breeding facility in Kent County). Mule deer, white-tailed deer, and Rocky Mountain Elk are the only three species of the family Cervidae that are known to be naturally susceptible to CWD. However, it is very likely that other subspecies of C. elaphus are susceptible to the disease. Although no other deer in Michigan have tested positive for CWD (outside of the isolated Kent County case), it remains a major concern due to the large wild population of deer in the state.

**Symptoms:** Emaciation, wide stance, lowered head, droopy ears and excessive salivation.

**Damage:** Animal fatalities

**Control/Treatment:** Chronic wasting disease is both transmissible and infectious, but most details of its transmission remain to be determined. No treatment is available for animals affected with CWD. Once clinical signs develop, CWD is invariably fatal. Affected animals that develop pneumonia may respond temporarily to treatment with antibiotics, but ultimately the outcome is still fatal. Similarly, no vaccine is available to prevent CWD infection in deer or elk.

Two threatening animal diseases: Chronic wasting disease and foot and mouth disease.

## Programs and Initiatives

Note: These listings highlight the breadth of existing programs and initiatives currently under way, but are not intended to be comprehensive.

Michigan Aquatic Nuisance Species (ANS) Program

In 1996, Michigan developed its first comprehensive ANS state management plan to provide guidance on actions for the prevention, control, and impact-management for ANS that have invaded, or may invade, Michigan waters. This state management plan was updated in 2002, and includes a summary of accomplishments, goals, and activities. The MDNR was awarded funding through the Great Lakes Restoration Initiative in 2010, to update and continue the implementation of the plan. A core team of staff members and managers from the Fisheries, Wildlife, Water Resources, Recreation, and Law Enforcement Divisions (of the DNR and DEQ), as well as representatives from the Pesticide and Plant Pest Management Divisions (of the Department of Agriculture and Rural Development) and the Project Planning Division (of MDOT) are currently in the initial stages of updating the state management plan. The plan is accessible at http://www.michigan.gov/documents/deq/deq-ogl-ANSPlan2002_249062_7.pdf.

These efforts include the Asian Carp Control Strategy, which includes studies performed by the U.S. Army Corps of Engineers. The USACE Asian Carp Study stems from a nearly 80 million dollar initiative from the White House Council on Environmental Quality in 2007, involving a multi-pronged federal attack against Asian Carp. The Asian Carp study examines the possibility of permanently shutting down the Chicago waterway system that links Lake Michigan to the Mississippi River Basin, and coordinating state efforts in response to the Asian carp threat. Although some actions may be taken before the study is completed, a final recommendation on how to stop the movement of the Asian Carp and other related species is expected to be made by 2013. However, the USACE has been accused of moving too slowly to prevent Asian carp and other exotic species from invading the Great Lakes. The USACE will release a short list of possible solutions in 2013 to quicken the process. The USACE will pick up the pace under a revised strategy in which it no longer will devise a single preferred method. Instead, the agency will put forward several options and leave it to congress and the public to decide.

Proposed Legislation to Prevention Asian Carp Invasion

Due to Asian Carp being detected beyond established barriers and less than six miles from direct access to the Great Lakes, a bill (The Permanent Prevention of Asian Carp Act) was created to direct the U.S. Army Corps of Engineers to study the watersheds of the Illinois, Chicago, and Calumet Rivers, and their tributaries, that drain directly into Lake Michigan, to determine the feasibility and best means of implementing the hydrologic separation of the Great Lakes and Mississippi River basins to prevent the introduction or establishment of populations of aquatic nuisance species along that pathway. In 2010, this bill was introduced in the U.S. House of Representatives (H.R. 5625) and the U.S. Senate, but it was merely referred to committee (and thus "died"). Numerous similar legislative efforts have suffered similar fates or otherwise not been acted upon, such as the Asian Carp Prevention Act of 2013. The latest congressional bill is H.R. 4001, the Defending Against Aquatic Invasive Species Act of 2014, which was rated as having a slightly higher chance of making progress than the earlier efforts.

The Sea Lamprey Control Program

Administered by the Great Lakes Fishery Commission, this program may be the best example of integrated pest management in North America. The program costs over $20 million per year, but has been tremendously successful in protecting the multi-billion dollar Great Lakes fishery for millions of persons who fish or are involved in a related sector of the economy. Sea lamprey control efforts have resulted in a 90% reduction in sea lamprey populations throughout the Great Lakes. http://www.glfc.org/lampcon.php

National Strategy and Implementation Plan for Invasive Species Management

The National Strategy and Implementation Plan for Invasive Species Management was developed by a team of researchers and specialists. This plan is responsible for preparing the Forest Service to deal with the ecological and economic problems associated with the types of invasive species that affect the nation. The plan maps out a strategic direction for Forest Service programs, which include Research and Development, International Programs, State and Private Forestry, and the National Forest System.

Animal and Plant Health Inspection Service

The Animal and Plant Health inspection Service (APHIS) is responsible for protecting and promoting U.S. agricultural health, administering the Animal Welfare Act, and carrying out wildlife damage management activities. The APHIS mission is an integral part of U.S. Department of Agriculture's (USDA) efforts to provide the nation with safe and affordable food. In recent years, the scope of APHIS' protection function has expanded beyond pest and disease management. Because of its technical expertise and leadership in assessing and regulating the risks associated with agricultural imports, APHIS has assumed a greater role in the global agricultural arena. Now, the agency must respond to other countries' animal and plant health import requirements and negotiate science-based standards to ensure that America's agricultural exports, worth over $50 billion annually, are protected from unjustified trade restrictions. In response to needs expressed by the American people and Congress, APHIS' protection role also includes wildlife damage management, the welfare of animals, human health and safety, and ecosystems vulnerable to invasive pests and pathogens. In carrying out its diverse protection responsibilities, APHIS makes every effort to address the needs of all those involved in the U.S. agricultural sector.

The United States Geological Survey (USGS)

The U.S. Geological Survey plays an important role in federal efforts to combat invasive species in natural and semi-natural areas. USGS services include the early detection and assessment of newly established invaders, the monitoring of invading populations, contributions to the understanding of the ecology of invaders and the understanding of factors involved in the resistance of habitats to invasion. The USGS is also involved in the development and testing of prevention, management, and control methods. USGS science centers conduct research relevant to invasive species in Michigan, and these are located at La Crosse, Wisconsin (the Upper Midwest Environmental Science Center), and Ann Arbor, Michigan (the Great Lakes Science Center). Each state in the U.S. is also home to a USGS Water Science Center, some of which conduct or support research relevant to invasive species in the Great Lakes.

The USGS maintains databases that may assist with the monitoring and reporting of invasive species occurrences, as well as provide information on their control. A couple of examples of these resources include the Nonindigenous Aquatic Species Database, at http://nas.er.usgs.gov, and the National Biological Information Infrastructure (NBII), an electronic information network that provides access to biological data and information on the nation's plants, animals,

and ecosystems. Sophisticated modeling capabilities, to predict the potential distribution of invasive species, are also available through the National Institute of Invasive Species Science in Fort Collins, Colorado.

NOAA Great Lakes Environmental Research Laboratory (GLERL)

This agency includes research on aquatic invasive species, and focuses on the biological and ecological effects of these species in the Great Lakes, and on the prevention of new species introductions. GLERL houses the NOAA National Center for Research on Aquatic Invasive Species (NCRAIS), which helps to coordinate the agency's aquatic invasive species outreach efforts across the U.S.

Eastern Michigan University Detroit River International Wildlife Refuge Study

Researchers from Eastern Michigan University made an effort to study and help contain the spread of invasive species at the Detroit River International Wildlife Refuge, along 5,700 acres of the Detroit River and Lake Erie. In November 2010, EMU was awarded $487,000 by a program that is part of the National Oceanic and Atmospheric Administration. The purpose is to expand upon work that had examined the spread of phragmites australis (which impairs the refuge's economic and environmental viability), that had set up monitoring points, looked at efforts to control the reed, and also measured effects on water quality. The purple loosestrife and reed canary grass are among the invasive plant species that also might be studied. For the next phase of the project, researchers plan to use a combination of on-the-ground surveys, water quality analysis, and remote satellite detection of invasive species to study their spread. Locations will be mapped, and data will be presented in a new way that is designed to help refuge officials in making management decisions.

Michigan Invasive Plant Council

The Michigan Invasive Plant Council (MIPC) is a non-profit organization that spans a wide array of groups, including government agencies, commercial enterprises, conservation organizations, educational institutions, and the gardening public. MIPC is an affiliate organization of the Southeast Exotic Pest Plant Council and its mission is to protect Michigan from the threat of invasive species. The council develops and publishes an invasive species list; facilitates the exchange of information concerning the management, control, and monitoring of invasive plants; provides a forum for all interested parties to discuss issues relating to invasive plants; serves as an educational, advisory, and technical support council for all aspects of invasive plants and related issues; and helps to prevent future introductions of new invasive plants.

Emerald Ash Borer (EBA) Awareness Week

EAB Awareness Week provides information on the steps that everyone can take to prevent the spread of EAB infestation, as well as fostering a cooperative spirit between citizens, communities, government and industry to reduce the risk that the insect poses to the 700 million ash trees blanketing the state. During the week and throughout the year, the Michigan Department of Agriculture and Rural Development (MDARD) urges Michigan residents and visitors to learn about EAB, be on the look-out for and immediately report possible signs of infestation, and adhere to the State's order banning the transport of ash trees, materials and all firewood from quarantined areas. Each spring, many outreach, education and compliance activities are planned (or will be highlighted) to help increase awareness and understanding of the EAB. The EAB Awareness week is typically held during the last week in May.

Michigan Chronic Wasting Disease Task Force-Final Report

In 2003, Governor Granholm signed an executive order creating a task force to address the threat of Chronic Wasting Disease in Michigan's deer and elk populations. The task force includes five members appointed by the Governor, who serve as the voting members of the task force. The directors of the Department of Agriculture (now MDARD), Community Health, Natural Resources, Environmental Quality, State Police, and Transportation serve as non-voting members of the task force. In October of 2003, the task force presented its findings and recommendations in a report delivered to the Governor. The report can be found at www.michigan.gov/cwd.

Michigan Cooperative Suppression Program – Gypsy Moth Infestations

The main goal of the Cooperative Suppression Program is to provide technical and funding assistance to county governments. This allows them the opportunity to provide protection from severe gypsy moth populations. The objectives are 1) to reduce the risk of severe defoliation and 2) to reduce the nuisance created by large caterpillar numbers. A county, interested in participating in the Cooperative Suppression Program, enters into an agreement with MDARD to conduct the program. MDARD provides training, technical support and operational guidelines to the

county. The training and guidelines are used to identify areas for treatment. The State of Michigan enters into a contract with an applicant for treatment of the qualified areas and the county is granted up to 50% cost-share for the cost of conducting the program.

Aquatic Invasive Species Awareness Week

In a continued effort to raise public awareness about the negative impacts caused by aquatic invasive species, the State of Michigan has established the Aquatic Invasive Species (AIS) Awareness Week, usually the second week in June. An aquatic invasive species is defined as a waterborne, non-native organism that threatens the diversity or abundance of native species, the ecological stability of impacted waters, or threatens a commercial, agricultural, aquacultural, or recreational activity. The AIS Awareness Week recognizes that Michigan's expansive shorelines and inland waters draw millions of tourists and recreational users each year, and that appropriate preventive steps must be taken to protect the state's water resources from invasive aquatic species. The AIS Awareness Week is sponsored by the MDEQ's Office of the Great Lakes, working in collaboration with other state and federal agencies as well as private and nonprofit organizations.

**Some Mitigation Alternatives for Invasive Species**

- Restrictions on the import and transport of species carriers.
- Adjustments to hunting, fishing, and other policies and regulations related to wildlife populations.
- Use of barriers to prevent invasive species travel.
- Use of competing species or other population control techniques.

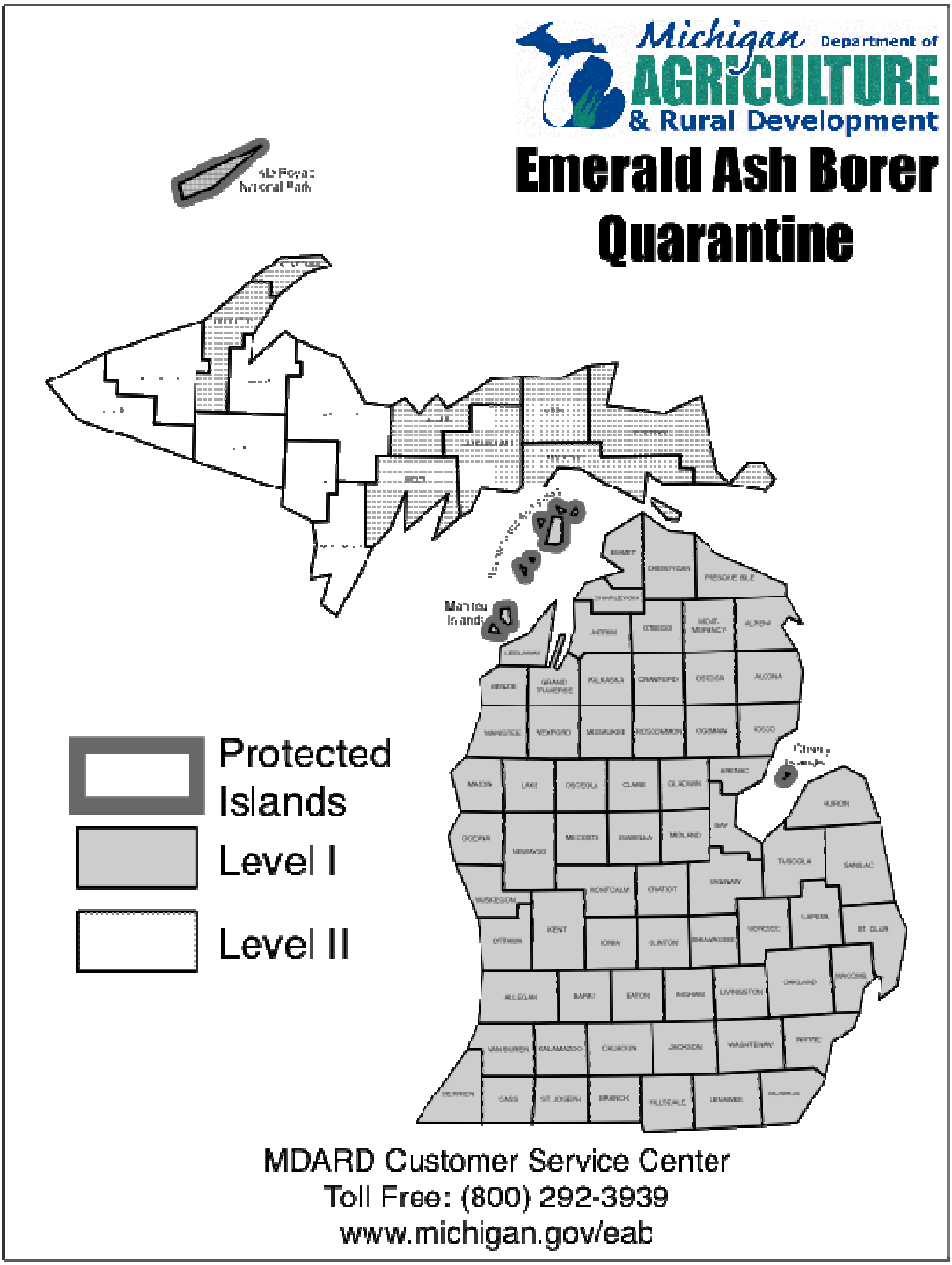
***Tie-In With Local Hazard Mitigation Planning***

Because many means of implementing mitigation actions occur through local activities, this updated MHMP places additional emphasis on the coordination of State-level planning and initiatives with those taking place at the local level. This takes two forms:

1. The provision of guidance, encouragement, and incentives to local governments by the State, to promote local plan development, and
2. The consideration of information contained in local hazard mitigation plans when developing State plans and mitigation priorities.

Regarding the first type of State-local planning coordination, MSP guidance has included the "Local Hazard Mitigation Planning Workbook" (EMD-PUB 207), which is currently being updated for release by 2015. For the second type of State-local planning coordination, a section later in this plan summarizes hazard priority information as it has been reported in local hazard mitigation plans. Here, it will merely be noted that no local hazard mitigation plans have yet identified invasive species as one of their top hazards.

## Emerald Ash Borer Quarantine Area Map, as of early 2014




Source: Michigan Department of Agriculture and Rural Development

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